ITF Southeast Asia Transport Outlook

Case-Specific Policy Analysis

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The International Transport Forum

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This report is part of a special edition series of the ITF Transport Outlook. Each looks at a different sub-region in Asia. Each report draws on the modelling framework and outputs from the ITF Transport Outlook 2021, desk research and insights from the ITF-UNESCAP joint capacity building workshop held virtually in October 2021 and the special event on "Transport Connectivity and COVID-19 Pandemic: Pathways for Greater Resilience and Sustainability", organised during the ESCAP Fourth Ministerial Conference on Transport from 14 to 17 December 2021.

The project was co-ordinated by Wei-Shiuen Ng (ITF), who, along with Mario Barreto (ITF), also contributed to the development and the finalisation of the draft. Jari Kauppila (ITF) provided a review of the document. Edwina Collins (independent) edited the report.

Foreword

The project *ITF Transport Outlook – Special Issues for Asia: Policy Analysis and Implementation* was developed jointly by the International Transport Forum and the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP). Both organisations have long collaborated closely and grant each other reciprocal observer status. Funded by ESCAP and carried out by the ITF, this project marks a new high point in this productive partnership.

The reports of this joint project will help member countries of both organisations to understand Asia's transport future better. How will demand for passenger mobility and freight transport evolve in the coming decades? What does this mean for transport-related emissions? And what impact could potential disruptions have? The Covid-19 pandemic has underlined the case for much more resilient transport systems, which require new and different transport policies.

Enhancing governments' capacity to identify critical differences in demand projections for passenger and freight transport between countries in different sub-regions in Asia and the rest of the world will help create a sound basis for necessary policy shifts.

The sub-regions covered by the project are experiencing rapid changes in transport demand, the evolution of mobility services and the provision of transport infrastructure. A primary objective of the work is to provide policy insights that help address the specific challenges in each sub-region and notably improve the sustainability of transport systems.

To support the implementation of sustainable transport pathways, the project included capacity-building and training sessions for each sub-region. The analyses also serve as input to priority actions on connectivity in the next phase of the ESCAP Asia-Pacific Regional Action Programme on Sustainable Transport Connectivity.

I look forward to building further on this excellent example of results-oriented collaboration between two leading intergovernmental organisations in the service of their members.

Young Tae Kim
Secretary-General, International Transport Forum

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Executive summary

What we did

This report provides recommendations on how to support Southeast Asia's strategy of economic growth through sustainable and resilient transport connectivity. The policy insights are based on the model-outputs of three policy scenarios for future transport demand and the associated carbon dioxide (CO_2) emissions in Southeast Asia to 2050. The baseline scenario (*Recover)* assumes government policies return to business-as-usual after the pandemic. Two other scenarios (*Reshape, Reshape+*) assume governments adopt more ambitious policies after the pandemic. Under the *Reshape+* scenario, governments additionally leverage the impacts of the Covid-19 pandemic for transport decarbonisation. The work forms part of the programme "ITF Transport Outlook – Special Issues for Asia: Policy Analysis and Implementation", carried out by the ITF in co-operation with the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP).

What we found

The economies of Southeast Asia are growing and connectivity improvements are planned to accompany this growth. This economic growth and increased connectivity is expected to be accompanied by increased transport activity.

The countries of Southeast Asia have a connectivity gap when compared to a highly connected economy in Europe. Some of this is down to physical distance between origin countries and destination markets, but there also appears to be a role for policy to play in reducing costs incurred at border crossings.

Freight demand in Southeast Asia will grow by nearly 80% between 2015 and 2030, under the scenarios modelled. Between 2015 and 2050, total tonne-kilometres in the sub-region could more than triple. As connectivity improves and freight volumes grow, strategies for Southeast Asia should consider how to manage this growth sustainably. Measures targeting shipping will be essential, as it accounts for approximately 90% of freight tonne-kilometres in the sub-region. However, road freight is far more carbon-intensive, making efforts to reduce the emissions from road-freight vehicles critical as well.

Demand for passenger transport in Southeast Asia will also grow considerably. Under all three scenarios, total passenger-kilometres will increase by a factor of at least 3.5. The continuing urbanisation of the sub-region drives part of this growth. Urban settings offer many opportunities to reduce emissions with policies that leverage cities' density and other characteristics. Such measures, including more strategic and integrated planning, can lower CO_2 emissions and make urban areas more liveable.

Non-urban passenger transport, including, sea, aviation, rail and road-based modes, will be the most difficult to decarbonise. By 2050, non-urban is expected to be the highest-emitting transport sector. All scenarios yield this result, including those with ambitious decarbonisation policies in place. Due to the nature of non-urban transport, there are also fewer policy measures available to policy makers to reduce emissions without significantly reducing demand. Against this backdrop, emissions reductions for non-urban transport will largely depend on a successful transition to low- and zero-carbon technologies.

What we recommend

Design measures that mitigate the rise of transport emissions as demand grows in Southeast Asia and connectivity improves

Improving connectivity to support economic growth is a strategic priority for economies in Southeast Asia. However, both can be associated with increased transport activity and therefore rising emissions. More ambitious policy measures will be required to prevent conflicts with other public policy objectives, such as the Paris Agreement or the UN Sustainable Development Goals. The *Reshape* and *Reshape+* scenarios indicate what such ambitious policies can achieve.

Target maritime transport as a critical sector for decarbonising freight transport in Southeast Asia

Maritime freight will account for approximately 90% of tonne-kilometres carried in Southeast Asia and without ambitious policies to decarbonise the sector, emissions due to shipping are expected to grow by 76% by 2050. The maritime policies reflected in the more ambitious scenarios (*Reshape*, *Reshape+*) could cut emissions by approximately half between 2015 and 2050.

Improved vehicle technologies will be important for decarbonising road transport as demand increases

Road transport's share of emissions is far greater than its share of transport volumes. Achieving a transition to low- and zero-emission vehicles is critical for decoupling demand for road transport from emissions. Improving vehicle fleets' emissions through vehicle standards for public transport and ridesharing or shared vehicles will be important to reducing the emissions.

Electrify rail networks to reduce emissions

The electrification of existing and new rail networks would reduce trip-based emissions through efficiency improvements. Emissions would be even lower if energy production upstream were to move away from fossil fuel sources for electricity production.

Improve cross-border trade facilitation to enhance connectivity

Border crossings could be made more seamless with the proper policy measures as well as planned investment in infrastructure. In particular, digitalised systems for the documentation of cross-border transport made a leap forward during the Covid-19 pandemic. Southeast Asian countries can build on the lessons learned to make trading across borders easier

Accelerate aviation's technology and fuel transition to reduce emissions

Air travel accounted for nearly a quarter of passenger-kilometres in Southeast Asia in 2015. By 2050, passenger-kilometres travelled by aircraft will more than double under all three scenarios. Under business-as-usual assumptions (the *Recover* scenario), emissions will also double. However, under the *Reshape* and *Reshape+* scenarios where lower emission planes and fuels are adopted, aviation's CO_2 emissions fall by c. 30% compared to 2015, with only a marginal reduction in the passenger-kilometres flown.

Leverage decarbonisation opportunities offered by urban transport

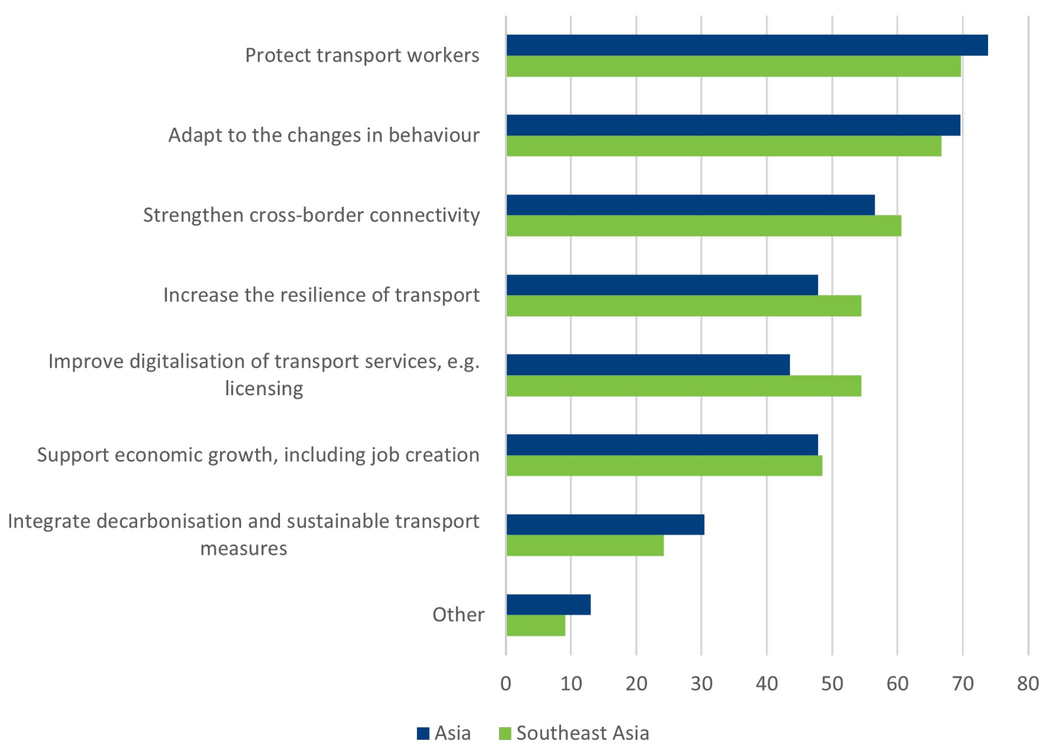
Southeast Asia's urban population is growing. This provides an opportunity to integrate urban development strategies and transport planning, to establish sustainable modes as attractive alternatives to privately-owned cars. Encouraging the use of low- or zero-emission delivery vehicles in urban settings is critical to lowering emissions from the expanding urban freight..

Pathways to decarbonise transport in Southeast Asia by 2050

Southeast Asia is a fast-growing region with increasing carbon emissions. Commitments to decarbonise transport sectors vary, however, decarbonisation is not necessarily the top priority in the sub-region, compared to priorities in the rest of the region. Therefore, opportunities for decarbonisation risk going unrealised, even as the sub-region is striving to "build back better" or deliver on its global commitments.

Figure 1 shows what Asian freight authorities consider to be freight priorities during the recovery from the pandemic. It shows that respondents in Southeast Asia rated border-crossings, transport resilience and digitalisation more highly than the average for countries in the rest of Asia, with economic growth being considered less of a priority than these two areas. On the other hand, decarbonisation rated lower among respondents from Southeast Asia than those from Asia more widely. It is important, therefore, to consider co-benefits and risks between strategies for the different policy objectives.

Figure 1. Major pandemic-recovery concerns of freight authorities in Asia and the Pacific



Note: UN ESCAP survey on freight transport policy responses to COVID-19, conducted in June and July 2020.

Source: Adapted from UN ESCAP (2020), https://asean.org/wp-content/uploads/2021/02/asean-covid-19-guidelines.pdf.

The UN ESCAP's definition of the Southeast Asia sub-region has been adopted for this report. This sub-region accounts for the following countries, which are all considered in this report: Brunei Darussalam, Cambodia, Indonesia, Lao People's Democratic Republic (PDR), Malaysia, Myanmar, Philippines, Singapore, Thailand, Timor-Leste, and Viet Nam. All the countries of Southeast Asia have submitted Nationally Determined Contributions (NDCs) to the UNFCCC under the Paris Agreement and have objectives to meet under the Sustainable Development Goals (SDGs).

The ITF presents this study on scenarios for future transport demand, passenger mobility, freight volumes and the associated transport emissions to 2050 for Southeast Asia. These scenarios assess potential impacts of future transport activity on climate change through detailed carbon dioxide (CO_2) emissions projections under different conditions. The ITF models used for the Transport Outlook are demand-based models that show what could be possible under certain policy scenarios, using policies that are already committed as the baseline. These ITF models are global models, and as such, there are limitations to how granular the results presented can be. Model outputs are therefore reported at the sub-regional level, except for specific project work such as the connectivity section. For the most recent ITF Transport Outlook (ITF, 2021), three scenarios were considered, *Recover*, *Reshape* and *Reshape+*. These are described in detail in Annex A, with the specific policies for each of the transport models in Annexes B, C and D – all of which are extracted from the original Outlook 2021. Figure 2 gives a high-level summary of the three.

Figure 2. Summary of the three ITF Transport Outlook 2021 scenarios

Recover	Current trajectory. Implemented and announced commitments. Established economic practices.
Reshape	A paradigm shift. Transformational commitments. Green recovery.
Reshape+	Reinforce and Reshape. Leverage Covid-19 recovery. Achieve decarbonisation faster and with more certainty.

The *Recover* scenario is the baseline in terms of policy measures. Under *Recover*, it is assumed that transport trends return to levels seen prior to the pandemic by 2025. It also assumes that only pre-existing planned or committed policies are implemented, so there are no additional policies that build on the pandemic experience. From a policy perspective, this could be considered the business-as-usual scenario.

Under *Reshape*, transport trends are again assumed to have returned to their pre-pandemic levels by 2025, and, it is assumed that significantly more ambitious policies to decarbonise transport will be implemented. This scenario is considered "transformational". It assumes policy measures that "encourage changes in the behaviour of transport users, uptake of cleaner energy and vehicle technologies, digitalisation to improve transport efficiency, and infrastructure investment to help meet environmental and social development goals." (ITF, 2021). Measures such as carbon pricing or port fees would be assumed to be more stringent, while the attractiveness of more sustainable modes would be increased. The improved attractiveness would be due to assumed lower penalties for multimodal interchanges, greater investment in infrastructure and services, more efficient operations (through asset sharing in freight, for example) and broader uptake of innovative solutions and alternative fuels or power.

Reshape+ is the most ambitious of the three scenarios. It assumes that "governments seize decarbonisation opportunities created by the pandemic, which reinforce the policy efforts in Reshape." (ITF, 2021). Under *Reshape+*, any reductions in transport demand observed during the pandemic broadly continue, with a more ambitious policy package also being implemented.

This report summarises findings that will help stakeholders to better understand the future of demand in passenger mobility, freight volumes and transport-related emissions to 2050 for the sub-region. It can support public authorities in the sub-region in developing their policy pathways to achieve these objectives and in improving the actions on transport specifically, in their plans and future commitments.

Reshaping transport as economies develop

Southeast Asia's economies are among the fastest-growing in the world, yet considerable development gaps exist between the countries in this sub-region. Significant infrastructure development is planned for the coming years. The needs and focus between countries will differ and must be considered. Accommodating this growth in a sustainable manner is an important concern.

Economic and demographic trends are important for long-term transport planning. They influence travel patterns, consumption and demand – often requiring policy responses or planning for both transport and land-use planning. This section looks at the population and economic forecasts for Southeast Asia and considers prevailing transport trends and policy priorities, recent Covid-19 impacts and lessons learned from the pandemic.

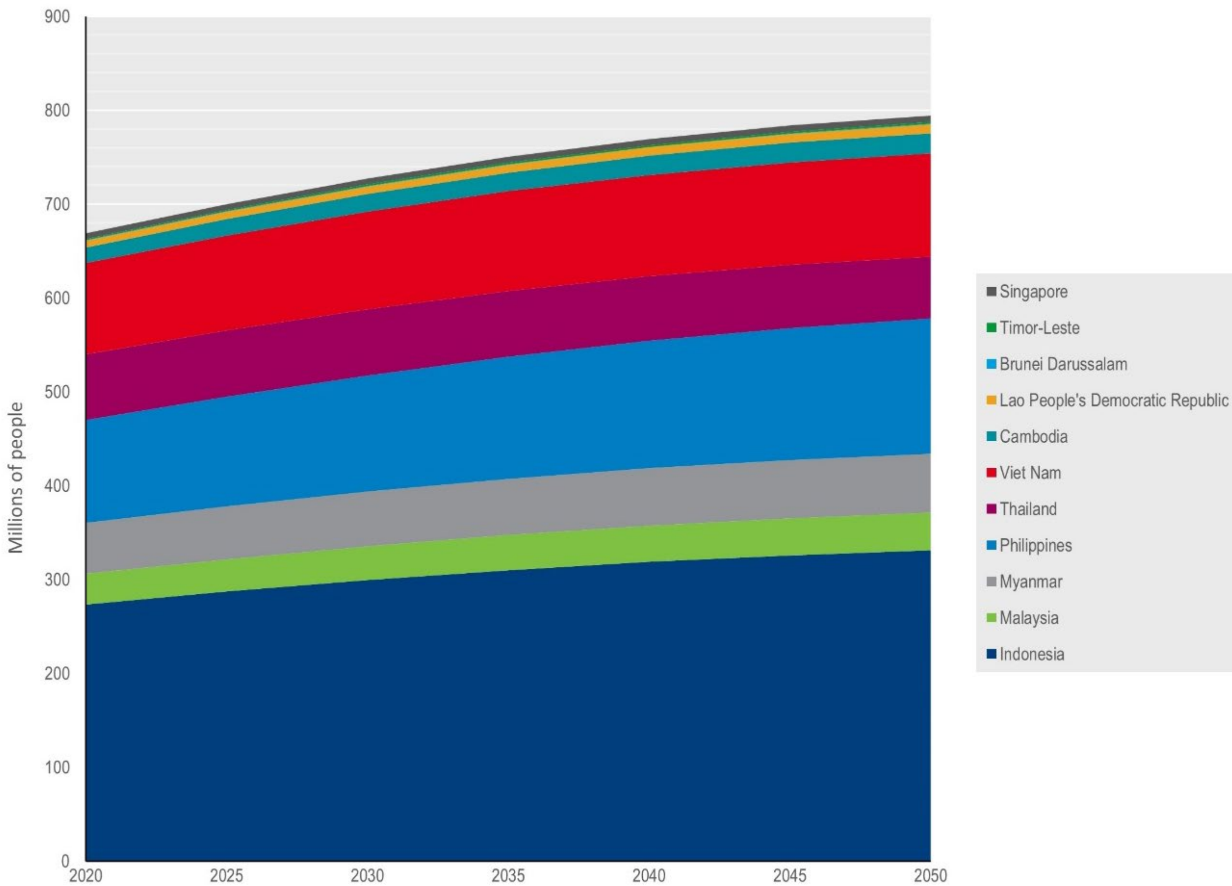
The human dimension: Balancing population growth and climate action

The population of Southeast Asia was estimated to be 662 million in 2019 (UN DESA, 2019a), with a quarter of the population being under 15 years of age. Between 2020 and 2050, the population of the sub-region is anticipated to grow by approximately 19%, reaching over 790 million by 2050 (UN DESA, 2019b), see Figure 3. However, this growth will not be uniform across the sub-region, with the greatest growth anticipated in Timor-Leste (projected to grow by over 50%), followed by the Philippines, Cambodia and Lao People's Democratic Republic (Lao PDR) (growth of approximately 30% each). Indonesia is projected to grow by 21% and Malaysia by 25%. The remaining countries see population growth of 10-14%, with the exception of Thailand, where a 6% decrease in population is expected (UN DESA, 2019b). Population-growth in Indonesia, the Philippines and Viet Nam, in particular, is expected to contribute significantly to growth in the region, accounting for "…98% of the increase in the working population…" in the ASEAN region and "…contributing 70% to 80% of [its] new consumer population" (WEF/Bain & Company, 2020).

This population growth in the sub-region is expected to result in an increase in transport demand for both passenger and freight transport. As urbanisation progresses, cities will also grow, with the number of cities with more than one million inhabitants expected to grow over the coming decades. This will likely change the densities and footprints of cities with implications for network planning, to ensure connectivity and accessibility. Policy makers must plan to mitigate the risk of increased carbon dioxide (CO_2) emissions that will come from the increased transport activity in Southeast Asia.

The age profile varies significantly across the sub-region (Figure 4). Among the countries in the region, Singapore and Thailand, in particular, will see their populations age, with the proportion of their populations aged over 64 rising to 33% in Singapore and 30% in Thailand. Brunei Darussalam and Viet Nam see their populations age somewhat too, with the proportion of those aged over 64 more than doubling in both places (from 6% to 22% in Brunei Darussalam, and from 8% to 20% in Viet Nam). However, these countries are starting from relatively younger populations in 2020, with 30% of the population in both countries currently under the age of 20 (UN DESA, 2019b).

Figure 3. Population projections of Southeast Asia countries to 2050

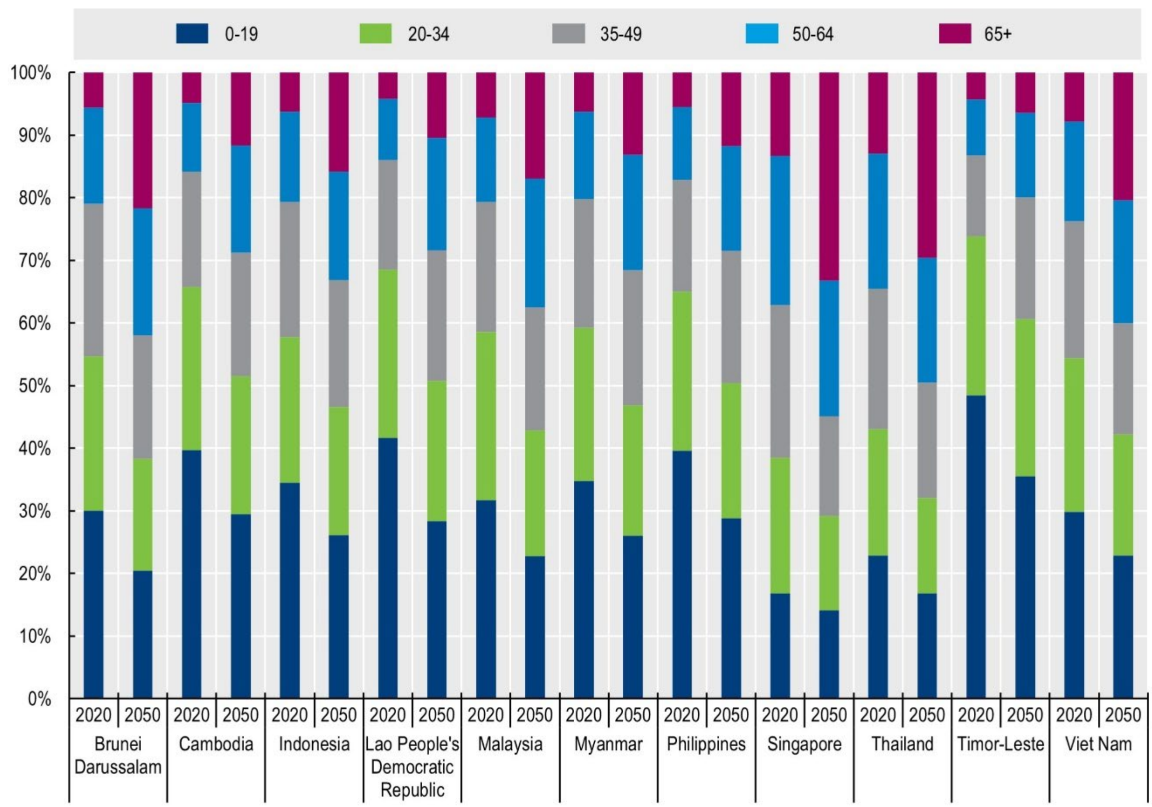


Note: Data are according to the medium-variant projections.

Source: Adapted from UN DESA (2019b), *Population Division World Population Prospects 2019* (database), https://population.un.org/wpp/.

The age profile of a population is important for transport policy makers to consider. As much as the working-age population growing can indicate a potential consumption boom, an ageing population can also have implications for transport policy as trip profiles and transport users' needs may change. This can affect the modes and routes required to ensure accessibility for older inhabitants, including those with mobility impairments. Road safety and affordability are also key concerns. Urban planning also has a role to play, where mixed-use and multi-age developments with access to essential services and social activities can support people ageing in their community (OECD, 2001; WHO, 2007; Schwanen and Páez, 2010; Frye, 2011; Metz, 2011; ITF/OECD, 2017).

Figure 4. National population by age (%) in Southeast Asia countries, 2020 and 2050



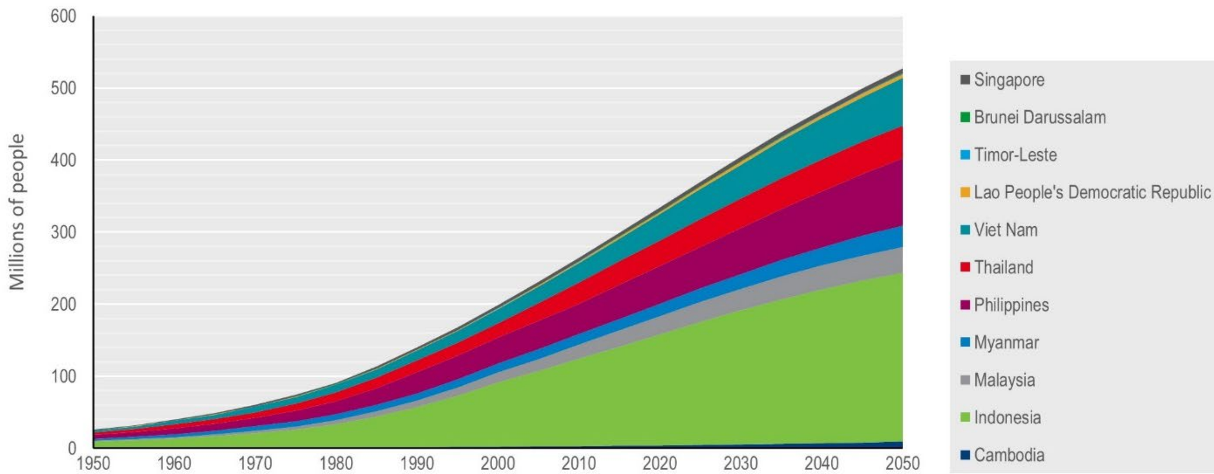
Note: Data are according to the medium-variant projections.

Source: Adapted from UN DESA (2019b), *Population Division World Population Prospects 2019* (database), https://population.un.org/wpp/.

Populations in Southeast Asia are not only growing, they are also moving. The urban populations of Southeast Asia have been growing since the 1950s and this growth is expected to continue through to 2050 (Figure 5). Several countries, in particular, are anticipating significant urbanisation over the coming years. Cambodia's urban population is expected to more than double between 2020 and 2050, reflecting both a growth in the national population but also an increase in the proportion of the population that lives in urban areas from 24% in 2020 to 41% in 2050 (UN DESA, 2018). Lao PDR is also expecting to see their urban population nearly double in this same timeframe. The urban populations of the Philippines and Myanmar are both projected to grow by over 70% and Indonesia over 50%. Even in Thailand, where the national population is not expected to grow, the urban population is expected to increase by roughly 27% between 2020 and 2050. In total, the proportion of the population dwelling in urban areas in Southeast Asia is expected to grow from 49% in 2018 to 66% in 2050 (UN DESA, 2019c).

Urbanisation, already identified as a strategic priority in the sub-region, will have implications for both land-use and transport planning in cities. Integrated land-use and transport planning can support efficient outcomes for transport and sustainable mobility options for inhabitants of the cities. Many cities facing significant urbanisation may also need to upgrade their public transport networks and provision, including infrastructure and services, while also considering what ancillary policies would support sustainable growth in the years to come.

Figure 5. Population living in urban areas in Southeast Asia countries, 1950-2050



Source: Adapted from UN DESA (2018), *World Urbanization Prospects: The 2018 Revision* (database), https://population.un.org/wup/.

The economic dimension: Planning for growth

The overall economy of the Southeast Asia sub-region is expected to grow strongly in the coming years. The Association of Southeast Asian Nations (ASEAN) economy is projected to be "the world's next economic powerhouse" by the World Economic Forum (WEF/Bain & Company, 2020). Currently, the countries are a mix of lower middle income, higher middle income, and high income, according to World Bank categories (ADB, 2021). The growing population in the sub-region will be accompanied by an expanding middle class, along with the increased urbanisation discussed above. Consumption in the region is expected to increase, although some factors could potentially hinder the sub-region from achieving its growth potential. These factors include fragmentation of trade regulations across borders (WEF/Bain & Company, 2020). The economies of Southeast Asia vary broadly in terms of development and core industry sectors. Countries rely to differing extents on tourism, manufacturing and exports of various goods and services. E-commerce has also grown rapidly in the sub-region (OECD, 2021).

The development gap across the economies within the sub-region is significant. Singapore, at one end of the scale, is highly developed and has a comparable GDP per capita to the United States and a favourable context for doing business. Cambodia, Myanmar and Lao PDR, on the other end, are still developing economies with much lower GDP per capita, differing levels of urbanisation and lower (though varying) levels of internet access. Socio-economically, Brunei Darussalam, though wealthy, is also still considered a developing economy (WEF/Bain & Company, 2020). Southeast Asia attracts a significant amount of Foreign Direct Investment (FDI) and in 2019 the ASEAN member states recorded their highest level of FDI to date. The pandemic impacted FDI in 2020 (falling by 25%), but this was a lesser hit than FDI falls internationally, with the overall proportion of global FDI represented by ASEAN growing from 11.9% to 13.7% between 2019 and 2020 (ASEAN and UNCTAD, 2021).

The Covid-19 pandemic negatively affected the entire Southeast Asia sub-region, but differing rates of recovery have been observed among the individual countries (OECD, 2021). During the pandemic, economies dependent on tourism suffered heavily under the global travel restrictions imposed. These economies still face uncertainty in the rate of recovery that can be expected as variants and resurgent waves of the Covid-19 virus, as well as varying vaccination rates around the world, have slowed the reopening. The pandemic has put virus control centre stage, and the measures adopted in different countries to ensure the continued movement of goods across borders have allowed the export activity to continue where there was demand. Indeed, merchandise exports contributed to the economic recovery of several countries in Southeast Asia (OECD, 2021; UN ESCAP, 2021a). However, as other regions begin to recover, competition is increasing in the goods market. Furthermore, the emergence of the Delta variant of Covid-19 caused a return to more economically disruptive restrictions in the context of an initially slow vaccine roll-out. Uneven economic recovery is exacerbating inequality and poverty, with the majority of people who cannot escape poverty in the East Asia and Pacific region "expected to come from Indonesia, the Philippines, and Myanmar" (World Bank, 2021).

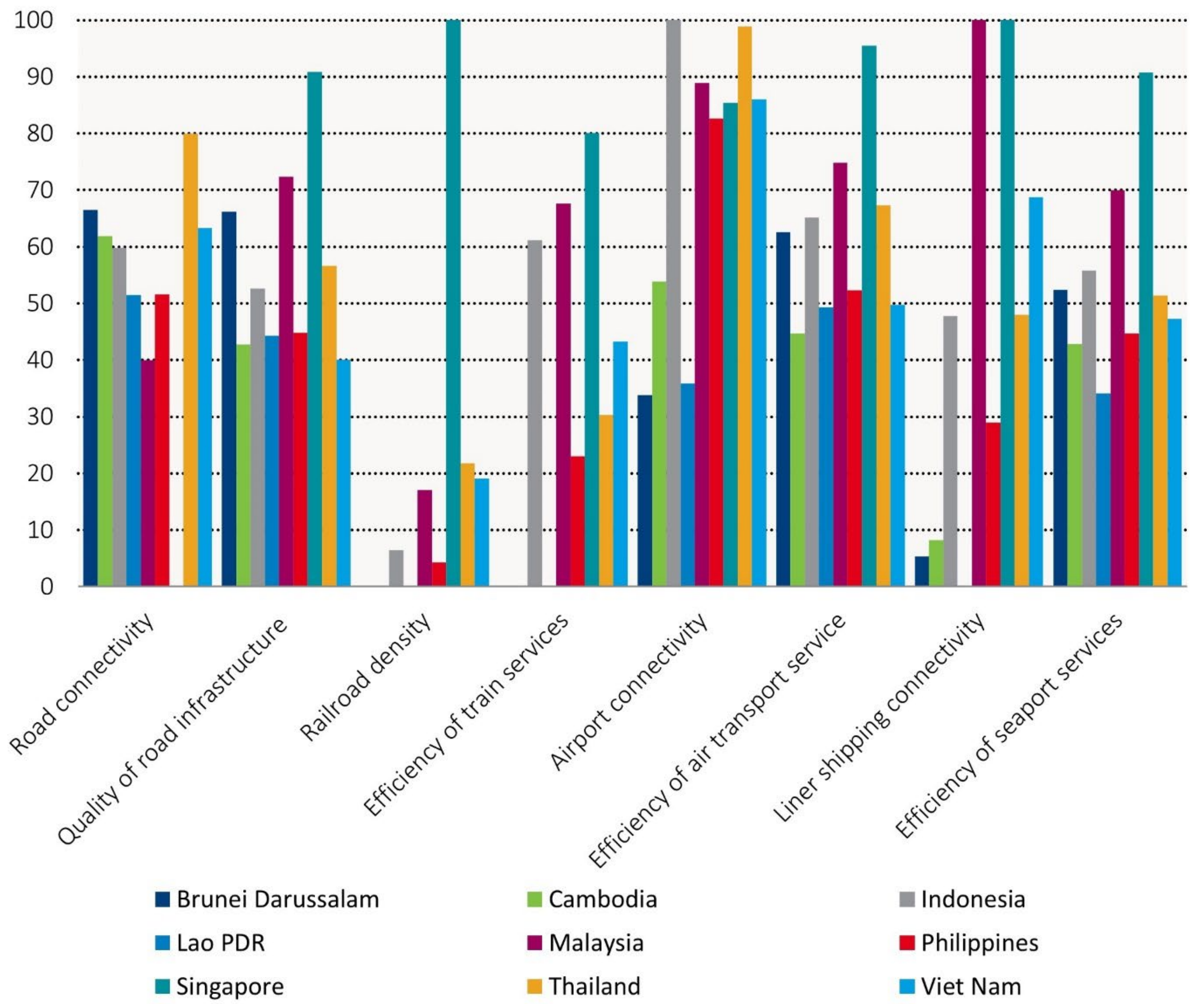
Efforts to improve trade in the sub-region have been underway for several years. Trade agreements have been signed to improve and ease trade in the sub-region, including opening previously restricted tendering processes to competition, reducing or eliminating trade tariffs, harmonisation of standards and cross-border facilitation. The agreements cover goods and services as well as investment and co-operation (Ministry of Trade and Industry Singapore, 2018, 2021; RCEP, 2020). Two key trade agreements, the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) and the Regional Comprehensive Economic Partnership (RCEP) have been signed in recent years. The CPTPP was signed between Australia, Brunei Darussalam, Canada, Chile, Japan, Malaysia, Mexico, Peru, New Zealand, Singapore and Viet Nam, and has been operating since 2018 (UNCTAD Investment Policy Hub, 2018). The RCEP agreement was signed in November 2020 between Countries in Southeast Asia (excluding Timor-Leste) and Australia, The People's Republic of China, Japan, New Zealand and the Republic of Korea. RCEP is anticipated to play an important role in the post-Covid-19 recovery of Southeast Asia and includes provisions specifically facilitating FDI and economic co-operation (UNCTAD, 2020).

Selected transport developments in Southeast Asia

Transport infrastructure is one of the decisive factors determining the connectivity of a sub-region. Southeast Asia is well situated at the crossroads of major global trade lanes, including Asia-North America, Asia-Europe, and Intra-Asia. Growing international business activities and booming sub-regional markets have led to a dramatic transport demand increase in all transportation modes. However, Southeast Asia is not a homogenous sub-region. The nature of transport requirements vary across the countries in the sub-region, which consists of a mixture of mainland, including landlocked countries, and archipelagic countries.

According to the World Economic Forum (WEF) global competitiveness report (WEF, 2019), there is a big disparity among Southeast Asian countries in terms of their overall transport infrastructure scores. The WEF transport infrastructure score consists of eight sub-indicators on road, rail, sea, and air transport infrastructure. These are road connectivity, quality of road infrastructure, railroad density, the efficiency of train services, airport connectivity, the efficiency of air transport services, liner shipping connectivity and efficiency of seaport services. The scores of the eight sub-indicators of the SEA countries are illustrated in Figure 6. Singapore, ranked number one in the world, is followed by Malaysia, ranked 29th. The countries on the Indochinese Peninsula form a group with some variation, and the rankings are Thailand (53rd), Viet Nam (66th), Lao PDR (87th), and Cambodia (96th). The two archipelagic countries, Indonesia and the Philippines, have quite different situations, being 55th and 102nd in the rankings, respectively. Meanwhile, the two countries (Myanmar and Timor-Leste) not included in the evaluation are also believed to have significant room for improvement.

Figure 6. World Economic Forum transport infrastructure scores for nine Southeast Asia countries



Source: UNESCAP based on WEF (2019).

Generally, the sub-region is on the core trunk routes of the global networks for air transport and maritime shipping. Nonetheless, a significant difference in the level of connectivity exists between the countries with and without a hub status. Additionally, the road and railway routes within the sub-region still require substantial investments, despite substantial achievements, such as the increase in kilometres of paved roads and the expansion of expressways.

The Asian Highways and Trans-Asian Railways networks are the backbone of the land-based transport infrastructure in Southeast Asia. Since its inception, they have been included in the plans of regional co-operation organisations and individual countries. For example, the Memorandum of Understanding on the Development of the ASEAN Highway Network (AHN) Project was signed in 1999 to connect 23 designated routes with a total length of 38 400 km. There are no longer missing links in the AHN, and the focus is to upgrade the Below Class III roads and the Class II or III sections with high traffic volume (ASEAN Secretariat, 2015b). As for railways, Indonesia (5 483 km), Myanmar (5 031 km), and Thailand (4 092 km) are the leading countries in terms of total railway length, followed by Viet Nam (2 481 km) and Malaysia (1 655 km). Most railways are not electrified, with the exceptional case of Malaysia (47.3%) (UN ESCAP, 2021b). Furthermore, to enhance the cross-border links in the sub-region, a flagship project to link

Singapore with Kunming in China was initiated at the 5th ASEAN Summit in December 1995, namely the Singapore-Kunming Rail Link (SKRL) Project. The SKRL will link major cities in seven countries – Singapore, Malaysia, Thailand, Cambodia, Viet Nam, Lao PDR, and Myanmar. As an integral section of SKRL, the electrified railway service between Vientiane and Boten on the Lao PDR-China border (414 km) was inaugurated in December 2021 (Medina, 2021). In addition, two more SKRL-related projects are included in ASEAN's latest transport strategic plan, a 255 km connection between Phnom Penh and Tra Peang Sre (Cambodia/Viet Nam border) and a 129 km connection between Loc Ninh and Ho Chi Mihn City (Cambodia/Viet Nam border) (ASEAN Secretariat, 2015b).

All of the coastal and island countries in Southeast Asia are well linked to the global shipping network primarily by direct shipping services and partially by transshipment through regional hub ports. However, Lao PDR, the only land-locked country in the sub-region, still experiences significant difficulty for port access. Based on the United Nations Conference on Trade and Development (UNCTAD) Liner Shipping Connectivity Index for 2011-2019 (World Bank, no date), shipping connectivity has been steadily increasing at a modest rate in all Southeast Asia countries. Viet Nam has the most notable annual growth rate, with the connectivity score increasing from 48.2 to 66.5[1] between 2011 and 2019, mainly attributed to its increasing participation in global value chains. However, the indices of the countries in the sub-region vary considerably. Based on the data of 2019, the top one, Singapore (108.1), is undoubtedly a world-leading hub, followed by Malaysia (93.8). Thailand (52.9), Indonesia (44.4), and the Philippines (30.6) form the second leading group. They are covered by regional shipping routes but must rely on transshipment for trans-oceanic routes serving inter-regional trades. The rest of the countries, Myanmar (8.5), Cambodia (8.0), Brunei Darussalam (7.7), and Timor-Leste (2.9), rely heavily on the ports of their neighbouring countries.

An expansion in air transport services has been observed for the Southeast Asia countries from 2011 through 2019, with an annual growth rate of 7.5% in passenger traffic for the entire sub-region (World Bank, no date). The ASEAN Single Aviation Market initiative is a critical factor in boosting growth. Particularly impressive growth has been observed for Viet Nam (15.7%) and Thailand (11.5%), mainly due to the investments in new and existing airports and the increased frequencies mostly attributed to the rising low-cost carriers. Although partly due to their low-base volume, Cambodia (14.0%) and Myanmar (11.6%) also made remarkable progress, directly resulting from their raised international engagements regarding trade, investments, and tourism.

Indonesia and the Philippines, the two archipelagic countries backed by vast domestic air markets, are ranked first and fourth in terms of passenger numbers and have an annual growth rate of 3.2% and 7.7%, respectively. For the air cargo side, the operations were stable in the sub-region, without any substantial growth. Singapore plays a dominating hub role, holding about 50% of the air cargo market. Viet Nam is the other notable country, achieving annual growth of 10.1% and market share increase from 3.3% to 9.3%. The achievement was mainly due to its successful transformation to participate in global value chains. As many multinational enterprises accelerate the relocation of manufacturing sites to Viet Nam and several Southeast Asia countries, air cargo volumes are expected to grow further. Finally, air links are essential for remote countries, and more investments will be needed for the under-served countries.

In addition to the above individual transport modes, multi-modal connectivity is crucial for operational efficiency and emission reductions. The network of dry ports can increase the operational efficiency of the highway and railway networks, extending their reach to wider areas and facilitating their integration with the region's seaports and other transport modes. UNESCAP's Intergovernmental Agreement on Dry Ports provides a uniform definition of a dry port of international importance, identifies the network of existing and potential dry ports, and proposes guiding principles for their development and operation. As of 2019, the Agreement has 14 Parties and covers 226 dry ports. Among them, 28 existing and 23 potential dry ports are in the Southeast Asia sub-region (UN ESCAP, 2019). The dry port at Savannakhet, Lao PDR was, for example, opened in 2016 on the border with Thailand. Together with others under construction and planning, the dry port system will help to transform a landlocked country into a land-linked country (MPWT, 2019).

The growing population and the fast urbanisation in this sub-region have led to a substantial rise in people's activity, with a consequent impact on mobility levels. For example, Indonesia's passenger transport activity grew by 43% between 2010 and 2019, reaching a level close to 115 billion passenger-kilometres. A diverse range of transport modes co-exist within urban areas to accommodate the growing needs. In particular, much travel in this sub-region is done by non-motorised transport (NMT), either walking, bicycles, or non-motorised paratransit, complementing the typical public transport services. App-based ridesharing services, such as Didi, Grab, Go-Jek, Uber, and Ola, are on the rise (UN ESCAP, 2021c). There is also interest in solutions such as bikesharing, demand-responsive transit and Mobility as a Service (MaaS). Smart mobility in this sub-region is expected to play an important role in making travels safer, smarter and greener (UN ESCAP, 2022).

Shaping tomorrow's transport: Strategic and policy priorities in the sub-region

As with the rest of the world, Southeast Asia is trying to recover from the impact of the Covid-19 pandemic, in the context of continuing uncertainty. However, the pre-existing priorities of urbanisation in the sub-region and the need for sustainable connectivity and mobility solutions continue to be important. The countries in the sub-region are actively pursuing plans for both strategic areas, although with different focuses. Strategic planning for a recovery from the pandemic that takes account of the other priorities can contribute to advancing sustainability objectives as the sub-region recovers.

Moving towards sustainable transport systems

As cities grow, so too does their need for more accessible and sustainable mobility. The trend towards urbanisation has strategic importance for transport policy making. Integrated land-use and transport planning can improve the outcomes for citizens. However, a focus on urbanisation should not result in the omission of planning for peri-urban and rural areas, as highlighted in the ASEAN Development Outlook (ASEAN Secretariat, 2021).

Climate change and resilience to disasters are of growing concern in the sub-region as the disaster risk-profile changes and increased frequency of weather-related disruption is expected. The development of liveable cities will be needed to account for the impacts of climate change (ASEAN Secretariat, 2021). Earthquake and volcanic activity, flooding and storms are the most prevalent disasters that cause damage and disruption in the sub-region. As well as the human cost, natural disasters inflict damage on infrastructure (OECD, 2018b). Damaged infrastructure creates costs both to repair or to rebuild the affected infrastructure but also in terms of disruption to the movement of goods and people.

All countries in the sub-region have made strategic plans to reduce the climate impact of transport, ranging from specific emission reducing transport or fuel targets to economy-wide plans (ADB, 2021). Cambodia, Indonesia, Lao PDR, Malaysia, Singapore and Thailand also have targets relating to the uptake of electric vehicles (ADB, 2021, POL-TAR-009). Thailand is developing a roadmap for electric vehicles through to 2035, targeting that 30% of vehicles manufactured in Thailand are electric by 2030, rising to 50% by 2035 (UN

ESCAP, no date). Brunei Darussalam, Indonesia, Singapore and Viet Nam have specific mode-share targets to be achieved by either 2030 or 2050 for passenger transport, while Thailand has a mode-share target for freight (ADB, 2021, POL-TAR-010). The Philippines have also prioritised road safety with their strategy, The Philippine Road Safety Action Plan 2017 – 2022. It targets zero road-deaths. They also aim to improve the overall condition of the vehicle fleet, increase bicycle lane provision and introduce Bus-Rapid Transit projects in major cities. Thailand, too has road safety objectives, taking a dual focus of infrastructure and road-user behaviour to improve safety (UN ESCAP, no date).

Land transport is a priority in the current transport strategies, with both rail and road receiving significant investment and planned development or improvement in the coming years (ASEAN Secretariat, 2015b). The ASEAN Connectivity Master Plan was published in 2016, to improve integrations, connectivity and inclusiveness in the sub-region (ASEAN Secretariat, 2016). However, as observed in the *ASEAN Development Outlook* (2021, p.159), the Connectivity Master Plan does not explicitly account for environmental goals for its projects and "It is unlikely that projects created in these circumstances will maximise opportunities for delivering to the triple bottom line to support livelihoods sustainably and inclusively."

Enhancing sustainable transport connectivity

The pandemic has caused serious disruption to global freight routes; including the new cross-border restrictions imposed. Even with the reduced transport demand caused by the Covid-19 pandemic, many transport systems, such as ports and inland transshipment hubs, are facing severe traffic congestion. Lockdowns, workforce shortages, and quarantine measures have led to operational delays and to capacity and service frequency reduction. This disruption of transport systems had a detrimental effect on Southeast Asian countries, which play a vital role in global value chains. The problems associated with the issues of container shortages and high logistics costs have jeopardised the economic recovery from the Covid-19 pandemic. Therefore, policy measures aimed at resilient cargo transport will be a high priority for the "new normal" in the sub-region post-Covid-19.

Improvements in flexibility and the introduction of electronic documentation have already been considered positive advances in the freight field. Work conducted by UN ESCAP and the ITF with the ASEAN Secretariat on guidelines for the Covid-19 recovery found that measures on facilitating easier border crossings should be taken forward as part of the recovery but also to improve trade facilitation in the long term. Regional co-operation and knowledge- and data-sharing were highlighted by ASEAN member states as important learnings from the Covid-19 pandemic, which also highlighted deficiencies in existing trade agreements (ASEAN Secretariat, UN ESCAP and ITF, 2021).

The nature of freight handling and freight-related concerns vary by country in the sub-region. For example, the roll-on-roll-off (RORO) operation is crucial for some countries to establish the interlinkage of land and maritime transport modes domestically and with neighbouring countries. Meanwhile, cross-border movements are also vital to the sub-region. In this regard, ASEAN transport facilitation agreements, such as the ASEAN Framework Agreement on Facilitation of Goods in Transit (AFAFGIT) and the ASEAN Framework Agreement on Facilitation of Inter-State Transport (AFAFIST), serve as a crucial basis to achieve integrated regional connectivity.

The ASEAN Strategic Transport Plan for 2016-25 (ASEAN Secretariat, 2015b) foresees the signing of several agreements to improve trade and liberalise the aviation sector both within the sub-region and with other regions, such as the European Union. Trade agreements can improve trade facilitation and open some sectors to enterprises from the agreement's party countries (Ministry of Trade and Industry Singapore, 2016). All eleven economies in the sub-region have agreements with China to participate in the Belt and Road Initiative (OECD, 2018a).

Improved connectivity by road is important to many of the countries in the sub-region. Several countries recognise the need to reduce their emissions from road vehicles, with plans now in place to improve electric vehicle and/or biofuel uptake in the transport sector (UN ESCAP, no date; Aquino et al., 2021; Thuy, 2021; Woof, 2021a, 2021b). The plans are generally reflective of the development gap in the sub-region, with the least developed countries prioritising connectivity and building essential infrastructure for their growing economies.

Railways are also a focus for climate action and connectivity improvement in the region. Lao PDR, Malaysia, Philippines, Thailand and Viet Nam are planning infrastructure improvements or expansions for their rail networks (UN ESCAP, no date; BRI Monitor, 2020; Burroughs, 2021; Medina, 2021). Several of these projects will include the electrification of the railways, reducing the CO_2 emissions due to rail, which formerly used fossil-fuels. These networks will also serve as a more sustainable alternative to road for freight moving across countries and the sub-region and will contribute to NDCs under the Paris Agreement. For example, Thailand is developing a motorway and railway master plan to improve connectivity. Bangkok's 20-year rapid mass-transit plan also sees rail developments and upgrades, including electrification, which will cover 55 km by 2030. The Philippines plan to increase their rail network to over 1 000 km, up from 77 km, by the end of 2022 (UN ESCAP, no date).

Viet Nam also plans extensive rail connectivity expansion, with plans to build over 2 000 km of new rail lines as part of their 2021-30 strategy. The rail network is ultimately expected to carry nearly 12 million tonnes (equivalent to 0.27% of the market) of freight annually and 460 million passengers (4.4% of the market) (Burroughs, 2021). For Lao PDR, the only land-locked country in Southeast Asia, connectivity by surface modes is essential. The Lao PDR-China railway, a 414 km electrified rail link that runs from the capital city of Vientiane to the Chinese border opened in December 2021. As well as improving connectivity in Lao PDR, it will also facilitate trade within the ASEAN region and with China. The line is expected see freight transport between China and Europe increase to 1.2 to 1.8 million containers per year. It is expect to attract mode shift of approximately 1.5 million tonnes from maritime freight by 2030 (Medina, 2021).

Freight shipping is very important in Southeast Asia, both for the movement of goods between countries and the movement through countries to and from neighbouring regions. Singapore has one of the busiest ports in the world, reaching 37.5 million 20-foot equivalent units (TEUs) in 2021 (Peck Gek, 2022). The existing port suffers from congestion, and a new mega-port is planned for completion by 2040. This new port will be equipped for digitalisation and automated functions (Koh, 2019). The Philippines, Thailand and Malaysia are also investing in improving digital systems to enhance operations (MIDA, no date; UN ESCAP, no date) and Viet Nam and Timor-Leste are investing in upgrading their port infrastructure (CL Brief, 2021; Labrut, 2021). Transhipments across the sub-region are facilitated through a network of dry ports that allow goods to be carried on by road and rail. Myanmar will explore expanding its network of dry ports in the coming years (UN ESCAP, no date). Given the geographic make-up of the countries in the sub-region, aviation is also an important mode, with several countries planning to expand their airport facilities. For example, since 2016, The Philippines reports having carried out 233 airport projects (UN ESCAP, no date). As all countries in the sub-region have submitted their intention to contribute to the Paris Agreement goals, the decarbonisation of aviation will be very important.

Box 1. Supporting regional co-operation on sustainable freight in Asia Pacific

The United Nations Economic and Social Commission for Asia and the Pacific (UN ESCAP) is working on a regional strategy to deepen sustainability in freight transport and give further momentum and coherence to initiatives being undertaken at the region-wide level for Asia-Pacific. The outline of the proposed strategy addresses common challenges and offers a guiding vision, objectives, linkages to SDGs directly supported, enablers, priority areas and implementation arrangements. This policy document could bring a range of stakeholders onto a common platform to plan and implement sustainable freight-transport policies that contribute to achieving SDGs in the decade of action for sustainable development.

Regional strategy to deepen sustainable freight transport in Asia and the Pacific

Guiding vision	Efficient, connected, safe and clean regional freight transport system to support the realisation of Sustainable Development Goals (SDGs)
Objectives	Providing coherence to the sustainable freight initiatives Creating synergies through partnerships Ensuring high-level political affirmation Sharpening the links between freight transport policies and SDGs
SDGs supported directly	SDG Targets 9.1, 9.a, 3.6, 12.3, 9.4, 7.3, 13.1
Enablers or cross-cutting issues	Strengthening governance for sustainable freight transport at a national level Enhancing co-ordination for sustainable freight transport at sub-regional level Building the capacity of transport officials Promoting use of digital transport technologies Encouraging private sector engagement for sustainable freight transport policies Diversifying sources of financing for sustainable freight transport
Priority areas	Decarbonising freight transport Building resilience of freight transport to effectively deal with climate challenges and pandemics Strengthening cross-border and transit-transport connectivity Enhancing rural freight transport linkages Improving urban freight logistics Reducing freight-transport-related accidents Increasing share of rail freight and other sustainable transport modes
Implementing arrangements	Establishing a sustainable freight co-ordinating platform Developing a sub-regional action plan on sustainable freight transport Monitoring and evaluating through a results framework

Digitalisation

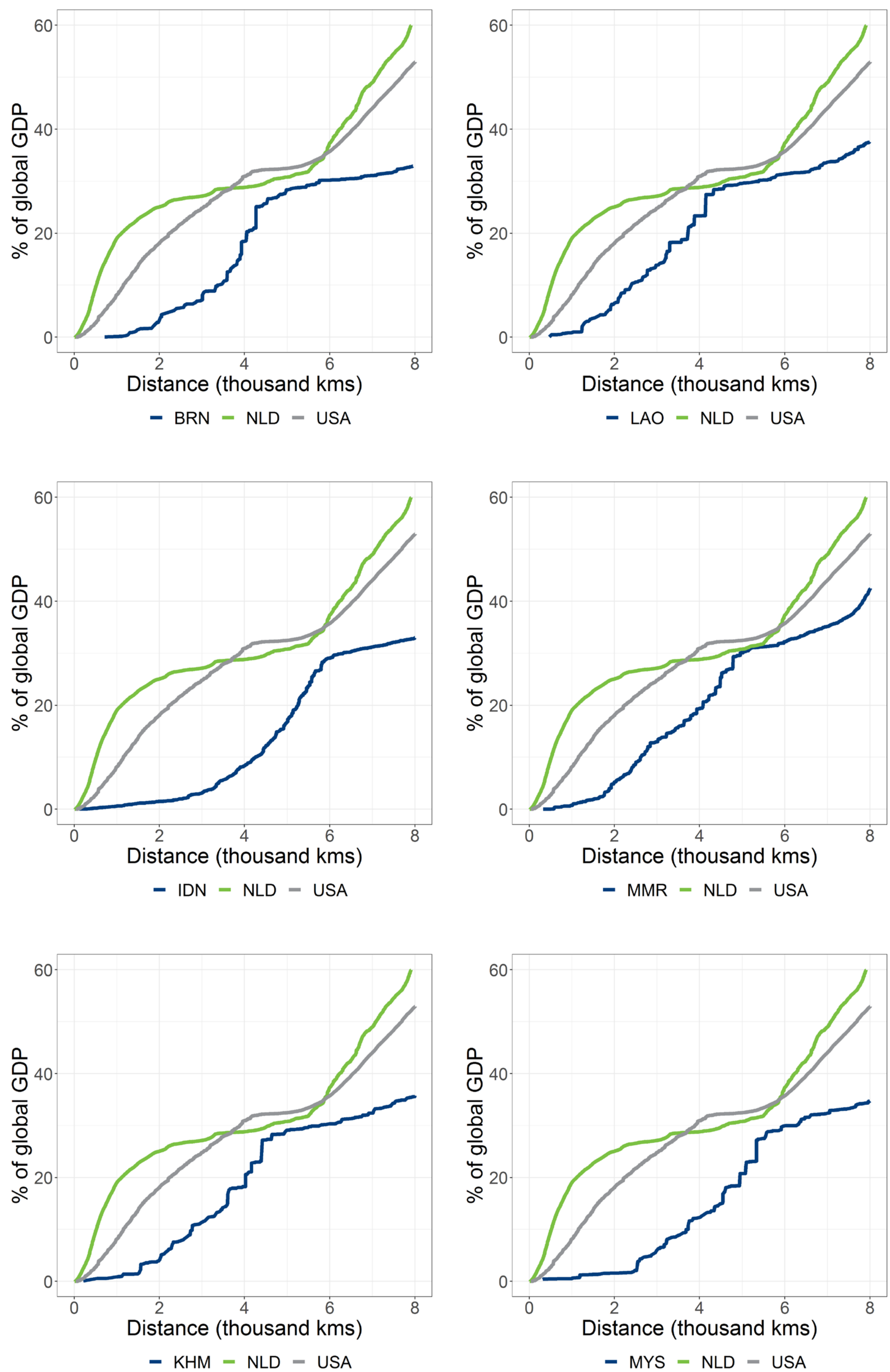
Digitalisation is very important for the recovery of the sub-region after Covid-19 (WEF, 2020; ASEAN Secretariat, UN ESCAP and ITF, 2021a). However, digitalisation had already been identified as important in the planning for this sub-region before the pandemic (ASEAN Secretariat, 2016; OECD, 2018c, 2021; ASEAN and UNCTAD, 2021). The World Economic Forum surveyed youths in six Southeast Asia countries (Indonesia, Malaysia, the Philippines, Singapore, Thailand and Viet Nam) on the impacts of the pandemic on their use of digital tools (including ridesharing, food delivery services and e-commerce). The survey found that 87% of respondents had "increased usage of at least one digital tool during the pandemic", and 42% had picked up a new one (WEF, 2020, p.8). The same survey found that 42% of respondents increased or started using e-commerce, reaching more than 50% of respondents from Indonesia and Singapore. Across all respondents, 13% increased their use of or started using ridesharing services and 9% increased or started using travel apps, although fewer-than-half of these respondents believed that this change in behaviour would be permanent (WEF, 2020).

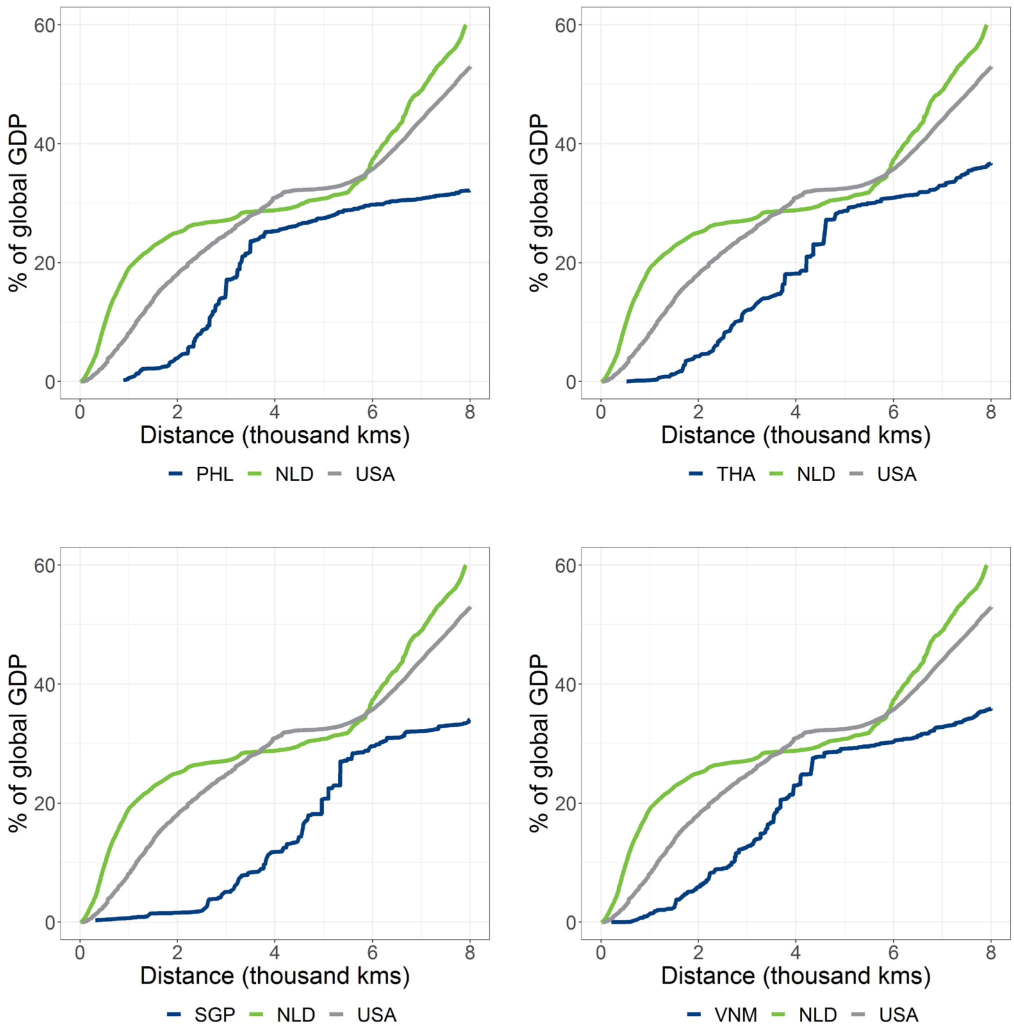
Several countries have policies specifically aimed at intelligent transport systems (ITS) and Information and Communication Technologies (ICT) (ASEAN Secretariat, 2015a; ADB, 2021). The digitalisation of areas such as health and education have been intensified by the pandemic and many countries are now further encouraging e-commerce (OECD, 2021). Digitalisation in trade and logistics, including using digital technologies and standardising processes to improve border crossings, will also be important for trade facilitation (ASEAN Secretariat, UN ESCAP and ITF, 2021; US-ASEAN Connect, 2021). An assessment by ASEAN concluded that companies in the sub-region are currently faring well, although with room to improve in this regard (US-ASEAN Connect, 2021). Digitalisation can also assist to decarbonise transport. Digitally enabled asset sharing can help to improve system efficiencies and reduce CO_2 emissions in road freight (ITF, 2018) and in shipping (ITF, forthcoming a). Efficiency improvements are also seen as important by the ASEAN member states as part of the Covid-19 recovery (ASEAN Secretariat, UN ESCAP and ITF, 2021).

The trade dimension: Addressing connectivity gaps

Connectivity is a strategic priority for the sub-region as it grows. Improving freight connectivity is a particular focus and many lessons have been learned or plans accelerated in response to the pandemic. This section looks at connectivity for each of the Southeast Asian countries, apart from Timor-Leste due to the lack of data. The first element is estimating how well connected individual countries are to their wider potential markets. The graphs in Figure 7 show how far goods must travel to access global GDP. For comparison, the graphs include the distances for the Netherlands (a highly connected country and the basis for the connectivity gap analysis below) and the United States (an example of a large, developed economy that trades internationally). For goods starting in the Netherlands, 20% of global GDP can be reached in slightly more than 1 000 km. For goods starting from the United States, this distance roughly doubles. No country in Southeast Asia has the same goods connectivity. The closest is the Philippines, from which goods can reach 20% of GDP in approximately 3 250 km, followed by Lao PDR and Viet Nam, at approximately 3 750 km. Brunei Darussalam, Myanmar, Cambodia, Malaysia and Singapore fall between 4 000 km and 5 000 km. Indonesia has the lowest connectivity, with goods starting in Indonesia needing more than 5 000 km to reach 20% of global GDP.

Figure 7. Impact of distances on reaching global centres of production and consumption





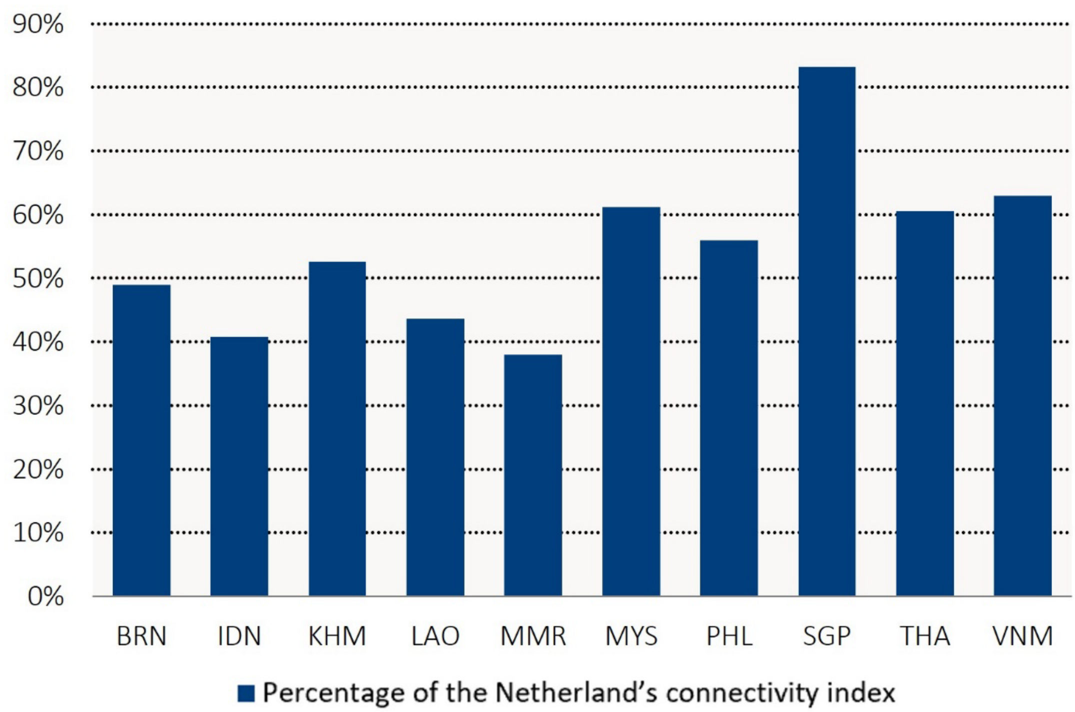
However, physical distance is not the only measure of the connectivity of a country. Freight transport is time-sensitive, and factors that cause delays, for example circuitous routes, border delays, or additional direct costs, such as tariffs or fees for processing border crossings, all impact how attractive a country is to do business with, and hence how well connected it is. Box 2 explains an indicator that can be used to estimate the connectivity of one country relative to another. Figure 8 shows how the connectivity of countries in Southeast Asia compares to that of the Netherlands, which is ranked as one of the most connected countries in the world.

Policy measures cannot overcome the actual physical distance to access wider markets impacting countries differently. However, policies aimed at reducing costs, such as improving and streamlining border crossing processes and costs incurred for cross-border trade, can improve access to global markets. This is clearly visible in the case of Singapore. Looking at distance alone, Singapore is one of the least well-connected countries among those in Southeast Asia. However, when costs of doing business (including border crossings, handling costs and travel time) are considered in addition to distance, Singapore is the most connected in the sub-region, having a connectivity gap of less than 20% to the Netherlands. In a

World Bank Group assessment of the ease of doing business in 190 different countries, on a range of measures, including cross border trade[2], Singapore is ranked second among the 190 economies for ease of doing business, demonstrating the importance of policy measures in overcoming distance for trade (World Bank Group, 2021a).

However, it is worth noting that Singapore ranks 47th for policies specifically relating to the border crossings, based on comparing costs incurred and time lost due to meeting border and documentary compliance requirements. The highest costs are to meet border compliance requirements – at more than double the costs incurred for border compliance in high-income OECD countries. Time lost is also a significant factor. Best regulatory performance economies cost importers and exporters only one hour for border compliance. However, in Singapore, border compliance is estimated to consume thirty-three hours for importers and ten hours for exporters (this is still better than the average for high income-OECD countries time for exporters) (World Bank Group, 2020h).

Figure 8. Connectivity gap for Southeast Asia countries compared with the Netherlands



Note: BRN = Brunei Darussalam; KHM = Cambodia; IDN = Indonesia; LAO = Lao People's Democratic Republic; MYS = Malaysia; MMR = Myanmar; PHL = Philippines; SGP = Singapore; THA = Thailand; VNM = Viet Nam

Malaysia, Thailand and Viet Nam all have connectivity gaps of less than 40% compared with the Netherlands. They are ranked 12th, 21st and 70th, respectively, by the World Bank Group for overall ease of doing business with, but 49th, 62nd and 104th , respectively, for trading across borders (World Bank Group, 2020e, 2020j, 2020i). Direct costs for border compliance for Malaysia and Thailand are lower than for Singapore, with the exception of import costs for Thailand. Costs for importers are also higher in Viet Nam. However, costs for documentary compliance are higher in Thailand and Viet Nam than in high-income OECD countries and Singapore, and time-related costs are higher in Malaysia, Thailand and Viet Nam (World Bank Group, 2020e, 2020j, 2020i).

The connectivity index of Cambodia is 47% and the Philippines is 44%. They rank fourth and fifth among the countries in the sub-region in terms of the connectivity gap (Figure 8). According to the World Bank metric on trading across borders, which does not take physical distance into account, Cambodia is ninth and the Philippines is seventh in the sub-region. The Philippines is recorded as having the highest costs for border compliance for both importing and exporting. Cambodia is one of the countries with highest time costs for documentary compliance (World Bank Group, 2020b, 2020g).

Indonesia, Myanmar, Lao PDR and Brunei Darussalam are all less-than-half as well connected as the Netherlands. Indonesia, despite being an established exporter in the region (KPMG, 2019) ranks among countries classed as developing when it comes to the connectivity gap compared to the Netherlands. According to a World Bank survey, Indonesia ranks 73rd for overall ease of doing business but 116th for trading across borders. Importers and Exporters incur greater costs, both direct costs and time costs, in Indonesia than many of its neighbours in the sub-region, and considerably greater than the average for the high-income OECD countries (World Bank Group, 2020c). For overall ease of doing business Myanmar ranks 165th, Lao PDR 154th and Brunei Darussalam 66th(World Bank Group, 2020k, 2020d, 2020a), yet Brunei Darussalam and Myanmar have the lowest scores in the sub-region for trading across borders (World Bank Group, 2020a, 2020f). However, when it comes to facilitating cross border trade, Lao PDR is ranked 78th among the 190 countries in the Doing Business project, and fourth in the sub-region – after Singapore, Malaysia and Thailand (World Bank Group, 2020d). Lao PDR compares favourably to several other countries in the sub-region on time and cost for border compliance but fares less well on the time and costs associated with documentary compliance (World Bank Group, 2020d). Policies to reduce these costs and streamline processes at borders could help reduce generalised costs for traders at the borders of all countries in the sub-region, to varying degrees, and thus improve connectivity.

Box 2. Measuring the connectivity gap between countries

The methodological approach for measuring connectivity in this report is a gravity-based model which measures how many opportunities (defined as GDP) can be reached from each country relative to other countries. The explanatory components are calculated for road, rail and maritime transport modes and include distance, transport cost (including border crossing and handling cost), travel time (speed) and border crossing time.

The following formula represents the indicator structure:

$$I = \sum_{c \; in \; countries} \frac{GDP_c}{\left({}^{g_c}/_{\beta} \right)^{\alpha}}$$

where g is the generalised cost, including all the explanatory factors; α is the elasticity of the index to the generalised cost and is set to equal 0.4 (a commonly used value for trade patterns elasticities); β is arbitrarily set so that the ratio gc/β is always below 1 and close to 1 for adjacent countries.

The index measures the “economic space” available to trade by country given the explanatory factors.

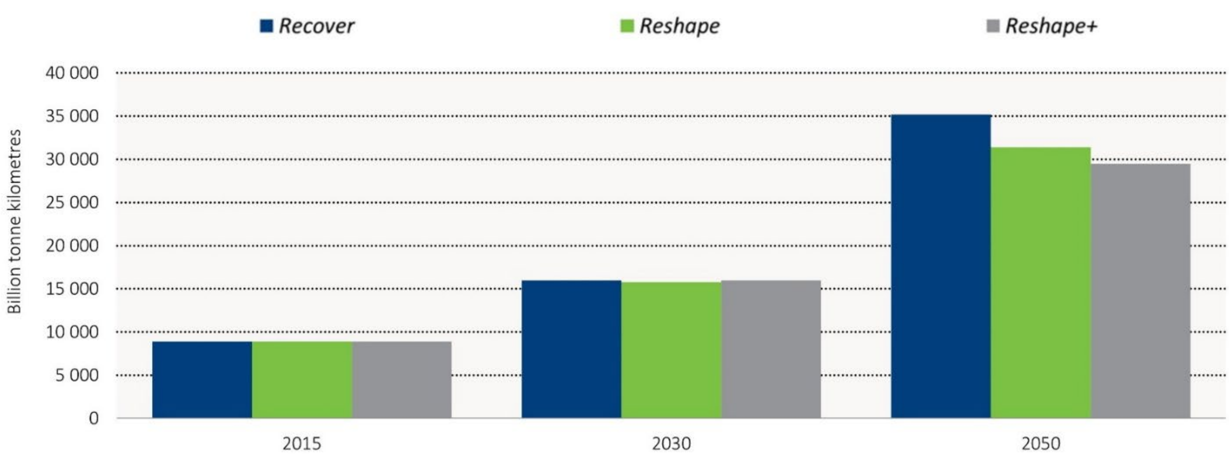
Source: extract from ITF, (2019b), “Enhancing Connectivity and Freight in Central Asia”, International Transport Forum Policy Papers, No. 71, OECD Publishing, Paris., p.45

Freight transport: Planning for significant growth

Freight transport is at the heart of transport strategies. Both in the short-term management of the Covid-19 crisis and in the longer-term as the population and economies in Southeast Asia grow, increasing consumption and demand for goods in (and from) the region. Any freight strategies will also need to address decarbonising the transport sector in the sub-region, while accounting for the projected growth in freight activity. Trade regionalisation, through recent and developing trade agreements, will also impact trade flows and mode choices over the coming decades.

Southeast Asia will see substantial growth in freight transport demand over the coming decades. Tonne-kilometres are projected to increase by nearly 80% between 2015 and 2030, and to have more than tripled (*Reshape* and *Reshape+* scenarios) or nearly quadrupled (*Recovery*) the 2015 baseline value by 2050 (Figure 9).

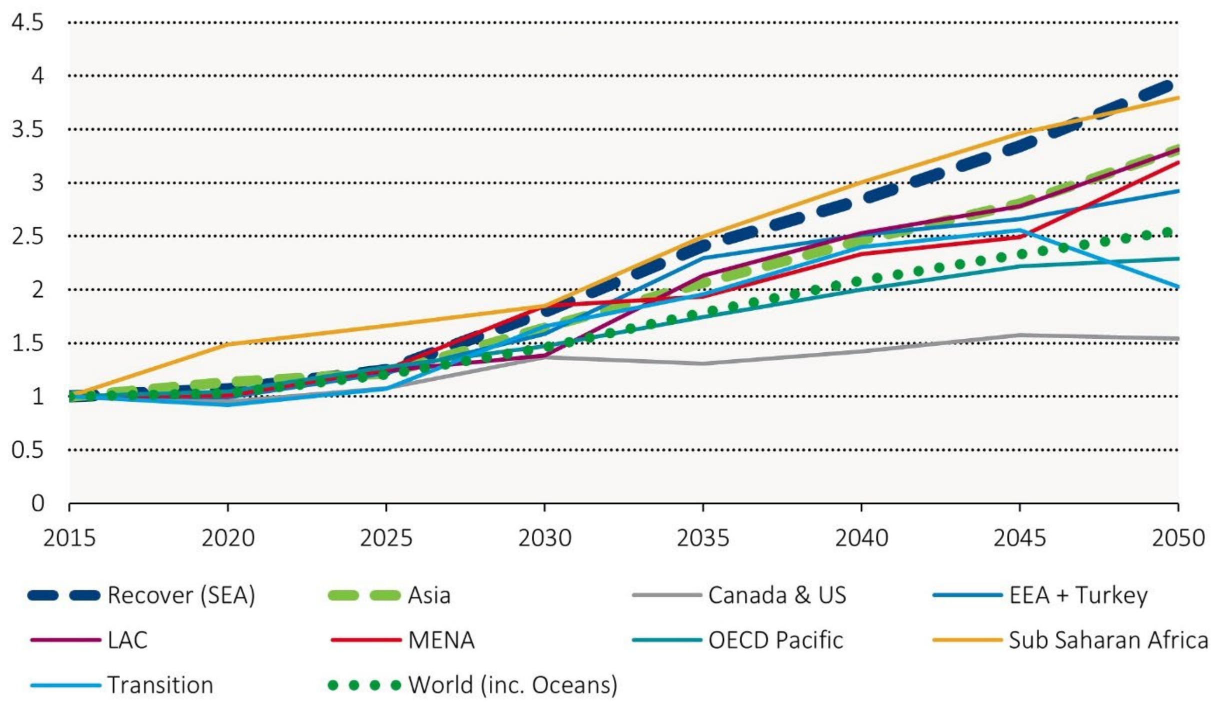
Figure 9. Freight activity for surface and domestic air and sea movements in Southeast Asia to 2050



Note: Figure depicts ITF modelled estimates. *Recover*, *Reshape* and *Reshape+* refer to the three scenarios modelled, which represent increasingly ambitious post-pandemic policies to decarbonise transport.

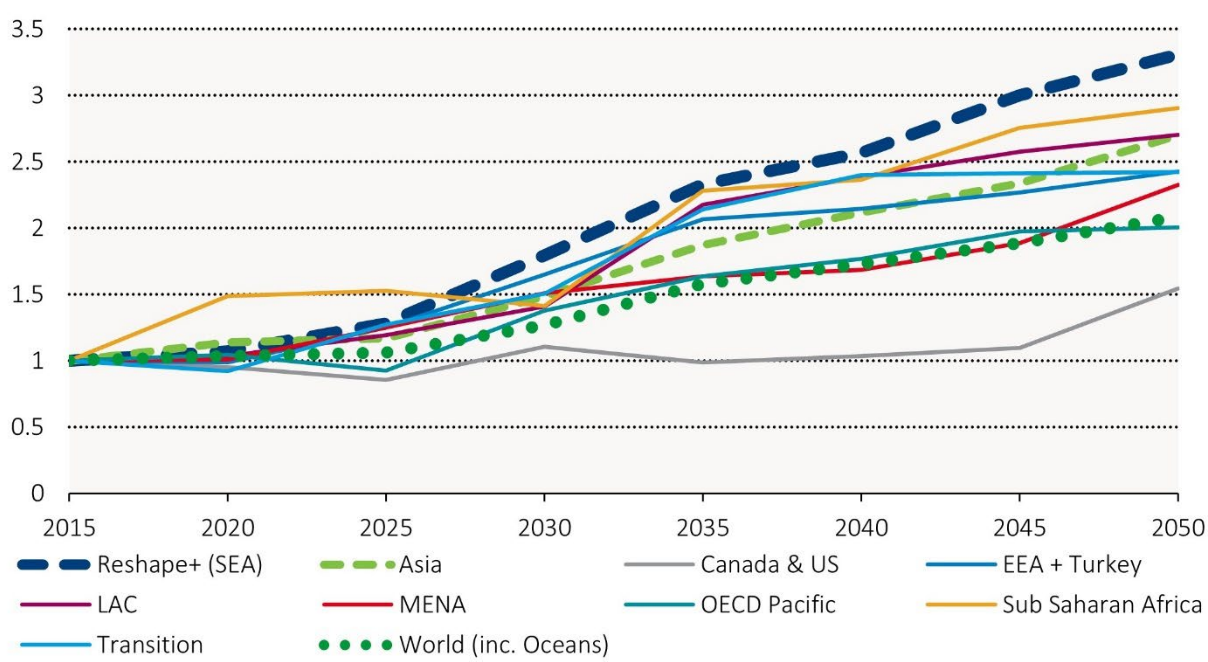
Internationally, freight activity in the Southeast Asia sub-region is expected to be one of the fastest-growing among the regions reported on in the ITF Transport Outlook 2021 (Figure 10) (ITF, 2021), relative to 2015 volumes. Even under *Reshape+* (Figure 11), where freight tonnes are not expected to grow to such an extent, the rate of growth in Southeast Asia relative to 2015 still outpaces other world regions by 2050.[3]

Figure 10. Indexed change in freight tonne-kilometres by region under a *Recover* scenario for Southeast Asia to 2050



Note: index year = 2015

Figure 11. Indexed change in freight tonne-kilometres by region under a *Reshape+* scenario for Southeast Asia to 2050



Note: index year = 2015

Non-urban freight: Encouraging sustainable transport for movement of goods

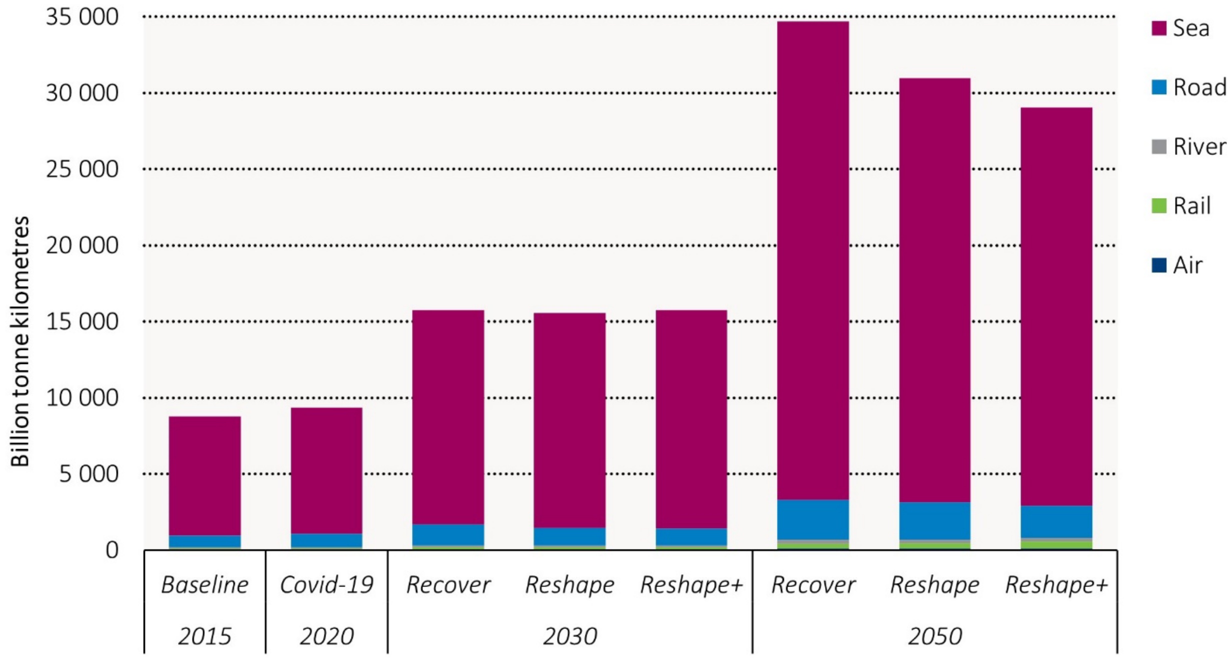
Should policy makers continue along a business-as-usual (Recover) trajectory, non-urban freight is to nearly quadruple between 2015 and 2050. With more measures in place, this increase can be lessened to 3.5 times under *Reshape* and 3.3 under *Reshape+*. The vast majority of the non-urban freight in Southeast Asia is carried by sea, accounting for roughly 88-90% of all non-urban freight tonne-kilometres (Figure 12). It accounts for over 7.8 trillion tonne-kilometres in the 2015 baseline.

Under Recover, sea kilometres quadruple between 2015 and 2050 (exceeding 31 trillion tonne-kilometres). This is moderated somewhat under Reshape and Reshape+, although in both cases, the sea kilometres still more than triple over the same period. Road has the second-largest demand, accounting for 7%-9.4% of transport activity to 2050. Road freight accounted for 771 billion tonne-kilometres in the 2015 baseline. This increases to 2.63 trillion tonne kilometres in 2050 under the Recover scenario, 2.43 trillion tonne-kilometres under Reshape and 2.10 trillion tonne-kilometres under Reshape+.

Rail and inland waterways will also be important to freight growth, with both modes carrying more tonne-kilometres than air-freight. Under *Recover*, tonne-kilometres for river grow by a factor of 3.4 between 2015 and 2050, and for rail that factor is 3.5. However, rail, which has a lower average carbon intensity than either road or air, becomes increasingly important under the more progressive scenarios with tonne-kilometres growing by a factor of 3.9 under *Reshape* and 5.3 under *Reshape+*. Under *Reshape+*, rail freight is expected to rise to 469 billion tonne-kilometres, more than four-times the tonne-kilometres carried by air freight.

Policies will need to encourage and support the use of the most sustainable transport mode for different goods. Measures such as multimodal interfaces can help to improve the access to, and efficiency of, interchanges. Policies focused on improved connectivity should also consider environmental impacts and strive to achieve sustainable connectivity. Improvements to rail and waterways will help to make them more appealing for trade routes, and again the interchange facilities will be vital to enable multimodal freight options and expand the catchment of stations and ports.

Figure 12. Non-urban freight demand by mode and scenario for Southeast Asia to 2050

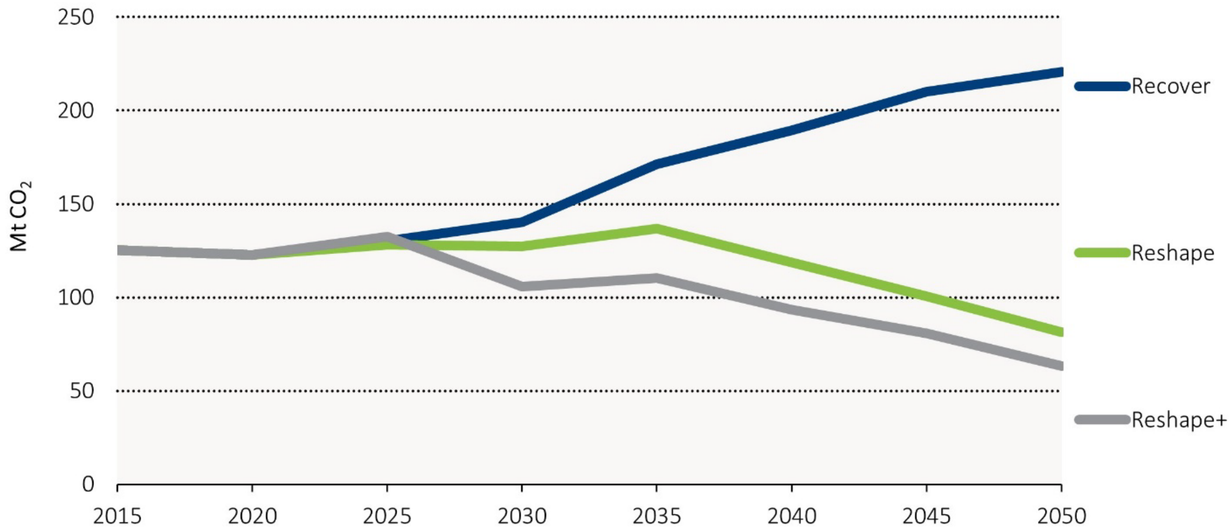


Note: Figure depicts ITF modelled estimates. *Recover*, *Reshape* and *Reshape+* refer to the three scenarios modelled, which represent increasingly ambitious post-pandemic policies to decarbonise transport.

Emissions projections

The significant growth in tonne-kilometres under the business-as-usual (*Recover*) scenario has a direct impact on the CO_2 emissions associated with non-urban freight in Southeast Asia. CO_2 emissions increase by more than 75% between 2015 and 2050 (rising from 125 Mt CO_2 to 221 Mt CO_2 in that time). Under a *Reshape*, emissions do rise between 2015 and 2035, but fall thereafter, ending up 35% below 2015 levels by 2050.Emissions begin to fall sooner under the most ambitious scenario, *Reshape+*, peaking in 2025 and already being 16% below 2015 levels by 2030, and reaching a reduction of 50% on 2015 levels by 2050. The trajectories for all three scenarios are shown in Figure 13.

Figure 13. Non-urban freight tank-to-wheel emissions by scenario for Southeast Asia to 2050



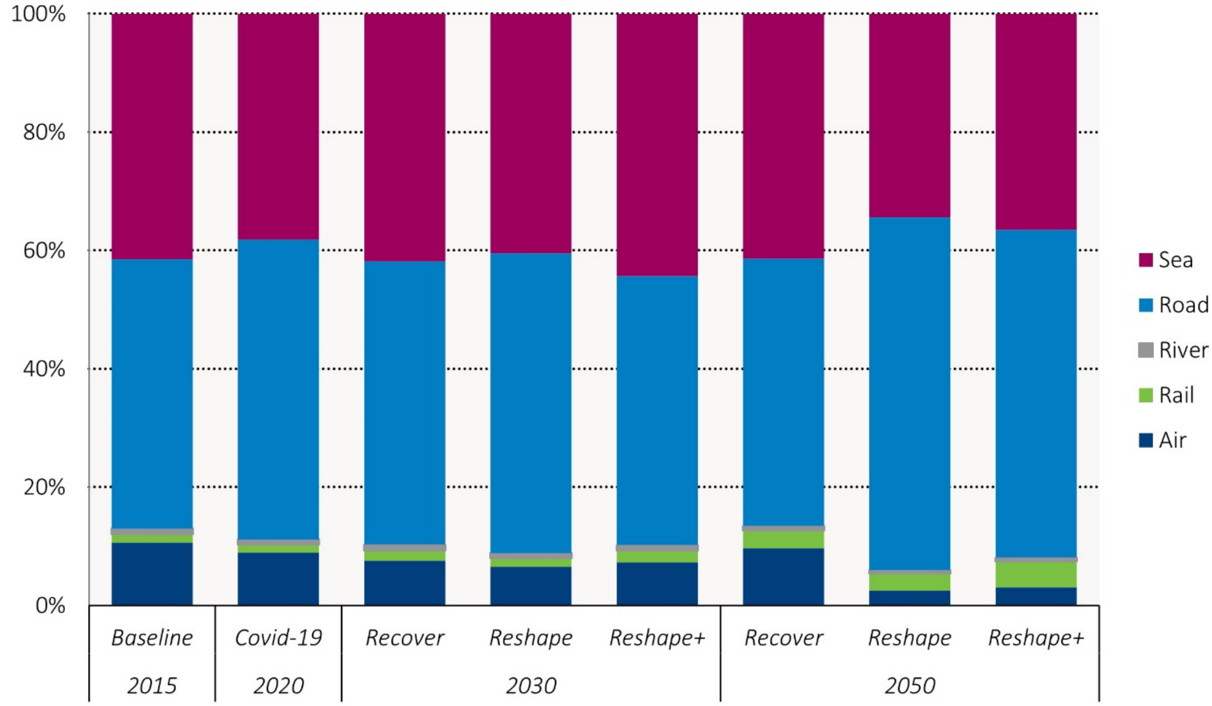
Note: Figure depicts ITF modelled estimates. *Recover*, *Reshape* and *Reshape+* refer to the three scenarios modelled, which represent increasingly ambitious post-pandemic policies to decarbonise transport.

Looking at the modal profiles of the emissions under the three scenarios (Figure 14), it is clear that the proportion of the emissions due to each mode are not proportional to the share of tonne-kilometres they carry. Despite carrying only 7 9.4% of tonne-kilometres, road freight accounts for between 45% and 60% of CO2 emissions (tank to wheel) to 2050. On the other hand, sea freight carries the vast majority of tonne-kilometres under all scenarios (roughly 90%) but only accounts for between 34% and 44% of emissions across the years and scenarios.

Despite the significant increase in sea freight tonne-kilometres under all scenarios between 2015 and 2050, the associated CO_2 emissions reduce by 46% in *Reshape* and 56% in *Reshape+*. Shipping is less carbon-intensive than road freight, and as such, road freight contributes a far greater share of freight emissions than shipping does when compared to its share of tonne-kilometres. Air freight retains a small modal share in terms of tonne-kilometres in the sub-region (0.3-0.4%), representing an absolute growth from 35 billion tonne-kilometres in 2015 to between 107-115 billion tonne-kilometres in 2050. However, the carbon intensity is expected to fall between 2015 and 2050 under both *Reshape* and *Reshape+*. This results in an 85% fall in CO_2 emissions, which fall from 13 Mt CO_2 in 2015 to 2 Mt CO_2 in 2050 under both scenarios.

Policy measures must focus on low-carbon intensity modes and technologies to meet the growth in freight demand. For sea freight, the deployment of slow steaming reduces emissions markedly between the *Recover* and two *Reshape* scenarios. For aviation, policies that promote sustainable aviation fuels or electric planes will be needed (and an assumption of sufficient advancement in the development of these) to reduce emissions. For road freight, policies should focus on reducing the carbon intensity of the vehicles. This includes an energy transition for heavy-duty vehicles, adoption of low-carbon fuels and fuel economy standards in internal combustion engines. Technology solutions, such as ITS, eco-driving and autonomous vehicles or platooning could also play a role in reducing emissions. In the case of all modes, carbon taxes would also encourage greater efficiency and the uptake of lower emissions technology.

Figure 14. Share of tank-to-wheel emissions for non-urban freight by mode and scenario for Southeast Asia to 2050

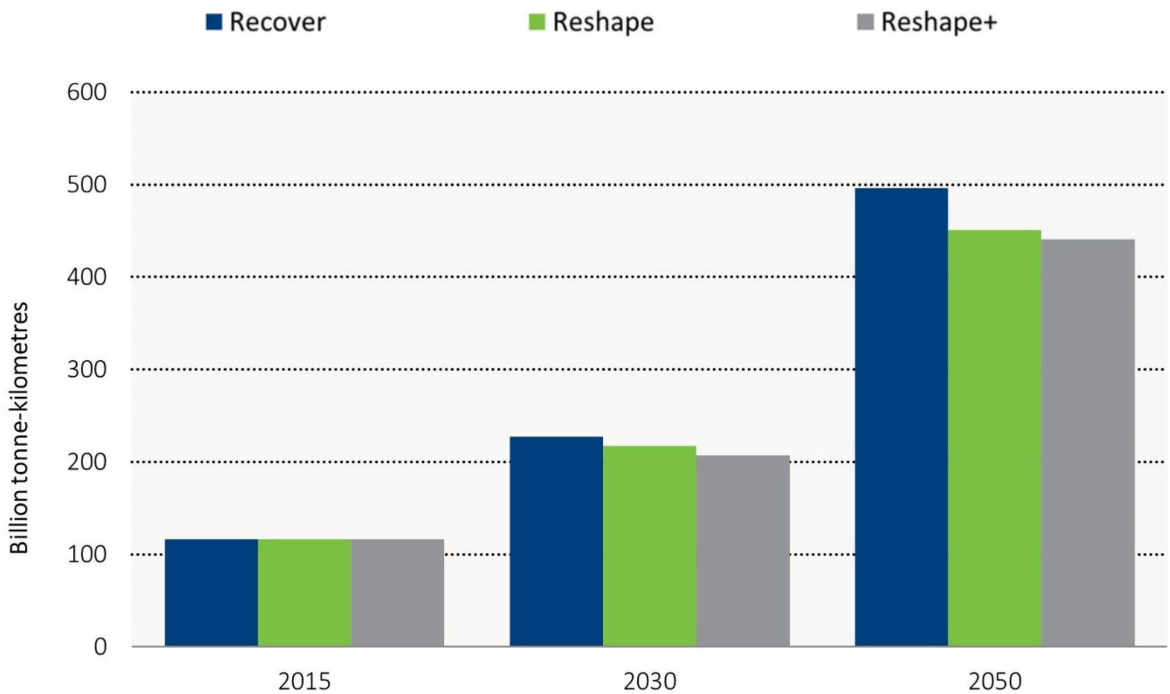


Note: Figure depicts ITF modelled estimates. *Recover*, *Reshape* and *Reshape+* refer to the three scenarios modelled, which represent increasingly ambitious post-pandemic policies to decarbonise transport.

Urban freight: Improving efficiencies and fleets

Urban freight in Southeast Asia is set to grow strongly, with tonne-kilometres to nearly double between 2015 and 2030 under *Recover*, and then more than double again between 2030 and 2050. The considerable level of urbanisation expected in Southeast Asia in the coming years, along with a growing economy and associated increase in consumption, implies that even the more ambitious policy scenarios of *Reshape* and *Reshape+* do not result in significant eradication of freight tonne-kilometres in urban areas. Under *Reshape* and *Reshape+*, freight tonne-kilometres still double between 2015 and 2050. The upturn in e-commerce will result in increased urban freight too. Policies will need to support more efficient deliveries to reduce vehicle kilometres, such as urban distribution centres to increase load factors on last-mile deliveries. Making better use of collection points for parcel deliveries and optimising routes can also help to limit tonne-kilometres. The just-in-time delivery approaches create problems with logistics and conflict with high load-factors. Uncontrolled returns policies (inverse logistics) could undermine efforts to optimise deliveries.

Figure 15. Total urban freight tonne-kilometres by scenario for Southeast Asia to 2050

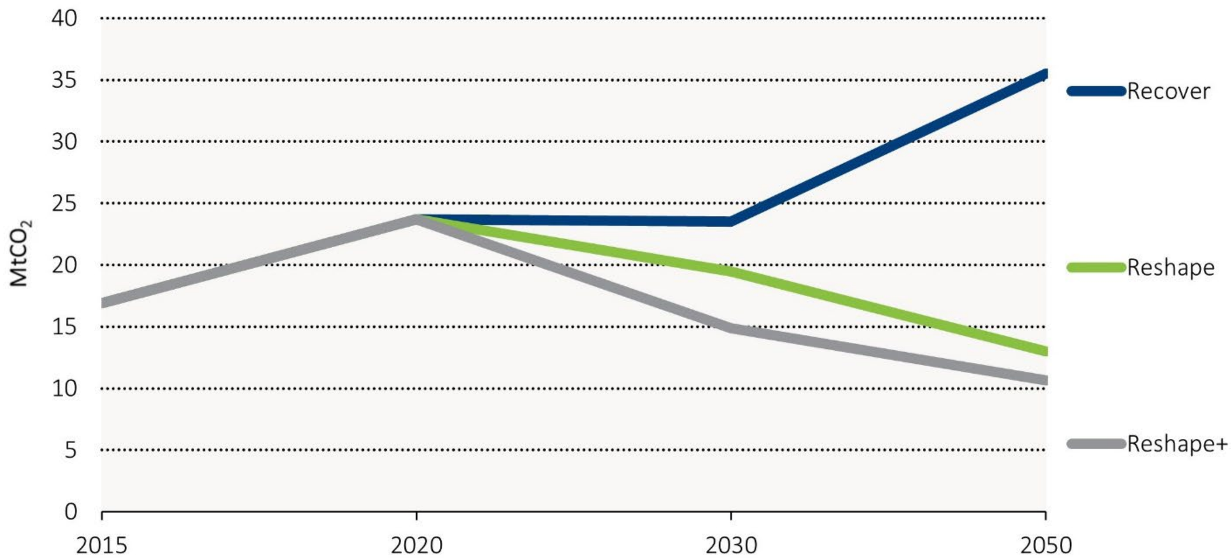


Note: Figure depicts ITF modelled estimates. *Recover*, *Reshape* and *Reshape+* refer to the three scenarios modelled, which represent increasingly ambitious post-pandemic policies to decarbonise transport.

Consistent with the growth in freight tonne-kilometres, emissions due to urban freight activity (Figure 16) will also grow. They double between 2015 and 2050 under *Recover*, growing from 16.9 Mt of CO_2 in 2015 to 35.5 Mt in 2050. However, the more ambitious policies of the *Reshape* and *Reshape+* scenarios would manage to mitigate the associated growth in emissions, even managing to reduce emissions below the baseline levels of 2015. Under *Reshape* the emissions due to urban freight would fall to 141.2 Mt and, under the *Reshape+*, the emissions would fall further to 121.2 Mt.

To achieve the levels of reductions observed in *Reshape* and *Reshape+*, policies will need to reduce emissions from the vehicles being used to complete urban deliveries. Electrification of urban delivery fleets can be an effective way to achieve this, provided the electricity comes from a renewable source. A 2019 ITF study in Korea looked at the cost-benefit of Korea Post using compact electric vehicles (EVs) instead of gasoline-powered motorcycles. It found that benefits of using EVs would outweigh costs, as well as reducing tailpipe emissions, the study found there were efficiency improvements, savings in staff costs, and staff also perceived safety and comfort improvements (ITF, 2019a). In addition to transitioning municipal delivery fleets, policy measures will need to encourage commercial operators to adopt more sustainable practices and vehicles. These can include charging infrastructure to support the roll-out of EVs and emissions or fuel-economy standards.

Figure 16. Urban freight CO_2 emissions by scenario for Southeast Asia to 2050



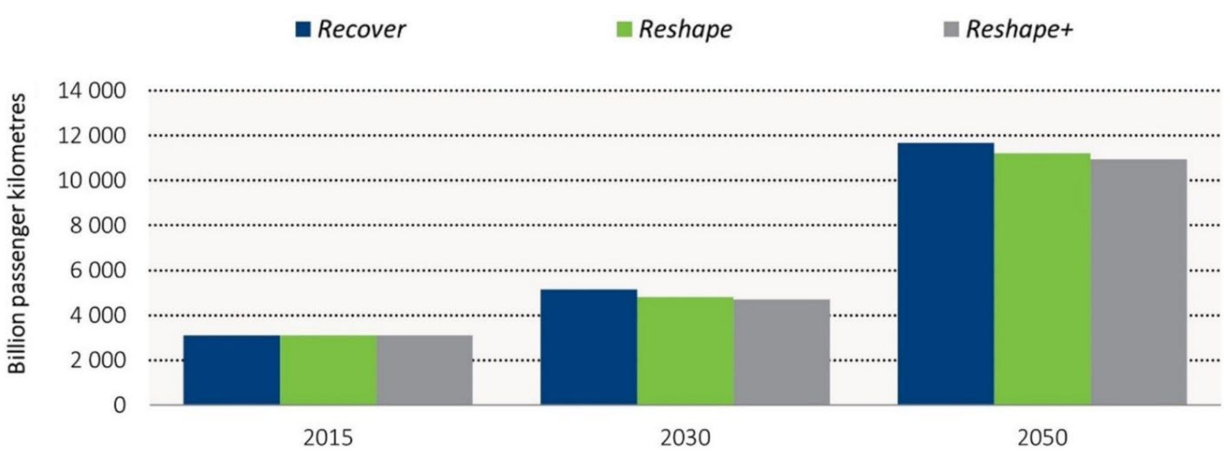
Note: Figure depicts ITF modelled estimates. *Recover*, *Reshape* and *Reshape+* refer to the three scenarios modelled, which represent increasingly ambitious post-pandemic policies to decarbonise transport.

Passenger transport: Sustainable transport for growing demand

Passenger demand in Southeast Asia is anticipated to grow considerably under the three modelled scenarios. Passenger-kilometres in the sub-region nearly quadrupling between the baseline in 2015 and 2050 (Figure 17). The more ambitious policies of *Reshape* and *Reshape+* see the total passenger demand moderated to some degree, but the increase is still a factor of at least 3.5 in all three scenarios. Passenger travel by inland waterway could not be modelled due to a lack of available data (e.g. services and activity).

Average passenger-kilometres per head of population increases by approximately 50% – 60% between 2020 and 2030 (accepting that there was reduced demand in 2020 due to the Covid-19 pandemic), with a population increase of roughly 9%. The average passenger-kilometres per capita slightly more than doubles between 2030 and 2050, with a further population growth of 9% over those two decades, based on the medium variant population projections from UN DESA (UN DESA, 2019b). Growing GDP would typically be associated with increased travel demand, and so the growing travel demand observed in these outputs would be consistent with expectations for a region undergoing the scale of economic growth anticipated in Southeast Asia.

Figure 17. Passenger activity in Southeast Asia by scenario to 2050



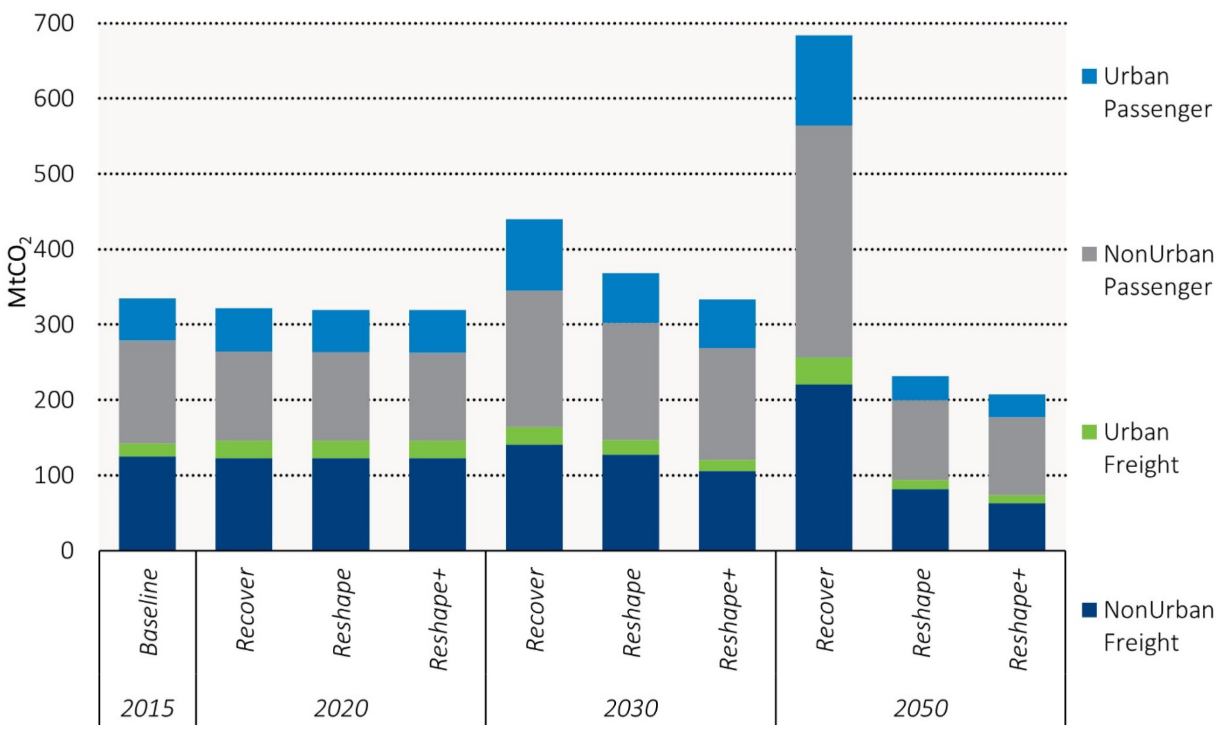
Note: Figure depicts ITF modelled estimates. *Recover*, *Reshape* and *Reshape+*, which refer to the three scenarios modelled, which represent increasingly ambitious post-pandemic policies to decarbonise transport.

The demand in passenger transport is closely split between urban (Figure 19) and non-urban (Figure 22) over the coming years. While the total number of passenger-kilometres for both urban and non-urban grow, urban passenger-kilometres do so at a faster rate. The following sections look more closely at urban and non-urban transport. From a sustainability perspective, it is also worth noting that in many countries in the sub-region, motor vehicle (including two-wheelers and cars) ownership has been growing steadily (OECD, 2018b).

Under *Recover*, the emissions due to passenger transport will more than double between 2015-50. Under the *Reshape* and *Reshape+* scenarios, the emissions will grow initially before falling back again by 2050, ultimately being 30% lower in 2050 than they were in 2015. Looking at emissions from the passenger and freight sectors together in Figure 18, it is clear that non-urban passenger transport causes the greatest single-sector CO2 emissions, accounting for 40–50 % of transport emissions between 2015 and 2050. The second-largest sector in terms of emissions is non-urban freight. Non-urban freight also remains as the second-largest emitter regardless of the policy scenario adopted.

Under *Reshape+*, emissions from non-urban freight can be halved, even as the freight activity grows between 2015 and 2050. Similarly, emissions due to urban passenger transport are halved, and those due to urban freight are reduced by 40% over the same timeframe. On the other hand, even under the most ambitious scenario of *Reshape+*, emissions due to non-urban passenger transport are only reduced by 20% between 2015 and 2050. This does represent a decrease in carbon intensity for non-urban passenger (as demand does grow over that period), but it indicates that this sector is the most difficult to decarbonise based on the policy measures and technologies currently seen as being available.

Figure 18. Total tank-to-wheel emissions for freight and passenger transport by scenario in Southeast Asia to 2050



Note: Figure depicts ITF modelled estimates. Recover, Reshape and Reshape+ refer to the three scenarios modelled, which represent increasingly ambitious post-pandemic policies to decarbonise transport.

Urban passenger transport: Cleaner vehicle fleets crucial for reducing emissions

The urbanisation of the population in Southeast Asia over the coming decades will contribute to a growth in the passenger travel demand in urban areas. The urban population for the sub-region is expected to grow by 76% (UN DESA, 2018) between 2015 and 2050. However, urban passenger demand is expected to outstrip this and grow by a factor of approximately 3.5 over the same period.

As can be seen from Figure 19, there is a small difference of roughly 7% in urban passenger demand between the *Recover* and *Reshape+* scenarios. Private vehicle passenger-kilometres also grow (approximately two-thirds of which are motorcycles), and the mode share for private vehicles is roughly the same (at approximately 36%) in 2015 and 2050 under *Reshape* and *Reshape+*. Under *Recover*, the mode share for private vehicles increases by three percentage points in 2050, reaching 39% of passenger-kilometres.

In the 2015 baseline and through to 2030 under all scenarios, informal transport (includes informal on-demand buses and three-wheelers) has the second-highest mode share. This position is maintained through to 2050 under *Recover*, but under *Reshape* and *Reshape+* the mode share for informal public transport shrinks. This reduction is due in part to the formalisation of the informal modes as part of public transport and shared modes (ridesharing, taxi and taxi-bus). This is primarily migrating to shared taxi-bus. However, informal modes are still expected to remain under the *Reshape* scenarios.

An interesting development is that active modes (walking and cycling) have the third-highest mode share (20%) in the 2015 baseline, but this declines under all scenarios. Under *Reshape* and *Reshape+*, active mode share has shrunk to 12% of passenger-kilometres. However, this should be considered in the context of growing city footprints – urban sprawl leads to lengthening of trip distances, which lends itself to longer trips by motorised modes rather than active modes. Passenger-kilometres for active travel do grow under all scenarios (more than doubling between 2015 and 2050, under the *Reshape* scenarios), but this growth is at a slower pace than that of the motorised modes, and therefore results in a fall in mode share.

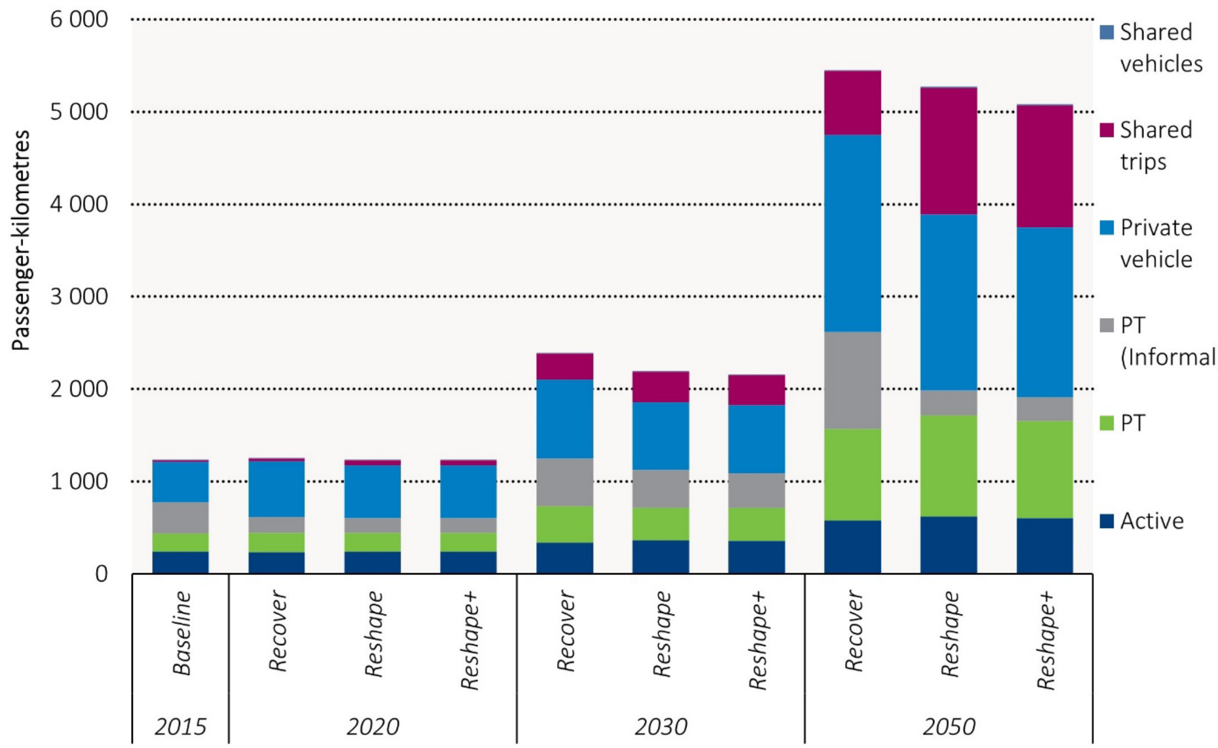
There is an overall increase in the proportion of vehicle-based urban trips in the coming decades despite the growth in passenger-kilometres for the more sustainable modes, the relatively constant mode share for private vehicles. This growth suggests that efforts to decarbonise urban passenger transport in Southeast Asia should focus on policy measures that reduce emissions from the vehicles being used. If private vehicles are to be used, they should be the cleanest vehicles possible.

The ITF is currently working with the ASEAN Secretariat on an initiative to support the implementation of the "Fuel Economy Roadmap for the Transport Sector 2018-2025: with Focus on Light-Duty Vehicles" (ASEAN Secretariat, 2019; ITF, 2022). The report, *Implementation of the ASEAN fuel economy roadmap* finds that ASEAN member states have already made progress on addressing tailpipe emissions, likely bolstered through the ASEAN mutual recognition arrangement on type approval for automotive products (APMRA) trade agreement. However, the report recommends that there is still progress to be made. Among the recommendations, and a keystone to further advances, is an agreed technical basis for the evaluation of CO_2 emissions and fuel economy. The capacity to conduct the necessary monitoring and the harmonisation of labelling and economic measures will enable the standardisation of fuel economy standards on a regional level (ITF, 2022).

Improvements to public transport will also be important in maintaining public transport ridership and attracting new users as the urban populations grow. This will be further discussed in the Accessibility section below. App-based mobility services may also be important for attracting users to sustainable modes, by improving accessibility to alternatives to the private car, such as public transport. This could include the development of digital sales channels for specific modes or by specific operators. Ridesourcing apps are already operating in many Southeast Asian cities, with super apps (which provide access to multiple services, not just mobility), such as GoJek or Grab also being established (ITF, forthcoming b).

App-based mobility can be a channel for improving standards in informal modes, where appropriate regulation is introduced. In Mexico and Uganda, for example, app-based mobility services Jetty (Mexico City) and SafeBoda (Kampala) were developed to formalise existing informal modes of transport and improve safety and comfort for users (ITF, 2019d). Mobility as a Service (MaaS) type applications, which offer whole-journey planning, real-time information and payment in a single interface to the user, could also aid with the attractiveness of sustainable modes. However, it should be noted that MaaS is still an emerging distribution model for mobility, and business models are generally still uncertain. See (ITF, 2021b, 2021c, 2021d) for discussion of regulating MaaS.

Figure 19. Urban passenger demand by mode and scenario for Southeast Asia to 2050



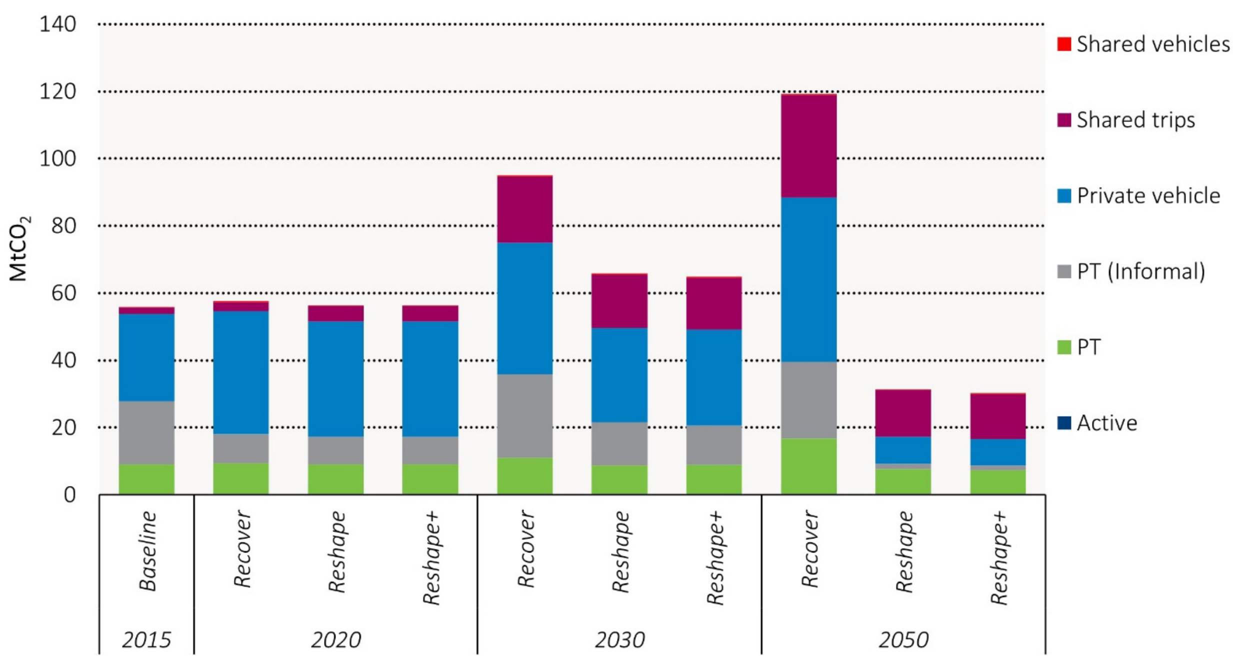
Note: Figure depicts ITF modelled estimates. *Recover*, *Reshape* and *Reshape+* refer to the three scenarios modelled, which represent increasingly ambitious post-pandemic policies to decarbonise transport. Active mobility and micromobility include walking, biking, scooter-sharing, and bikesharing. Public transport includes public transport (PT) rail, metro, bus, light rail transit (LRT), and bus rapid transit (BRT). Paratransit includes informal buses and PT three-wheeler. Shared vehicle includes motorcycle and car-sharing. Private Vehicle includes motorcycles and cars. Shared mobility includes taxis, ridesharing, and taxi buses.

Work by the ITF to support the regulation of app-based mobility services in ASEAN member states (ITF, forthcoming b) has identified that regulation of such apps in several countries is lacking or unclear, leaving the apps in a "regulatory grey area", which could hinder their development. Purpose specific regulations should be adopted based on clearly established principles. Fair data governance requirements, relating to data sharing and reporting should be established to encourage developers to know they can participate in the market without risking their position. Authorities also need to develop adequate infrastructure and capacity to manage the data that results from app-based mobility. Co-ordination among ministries with responsibilities for regulating and overseeing app-based mobility will be essential to its successful development (ITF, forthcoming b). For emerging mobility apps in general, authorities will also need appropriate capacity and digital infrastructure to monitor the market and benefit from new insights from the data reported by the app providers and the governance of the mobility aspects should be rooted in a broader mobility strategy (ITF, 2019c, 2021b, 2021c, 2021d).

Emissions for urban passenger travel (Figure 20) are set to more than double between 2015-50 if the trajectory of the status quo (*Recover*) is followed. This would see emissions for cities in Southeast Asia grow from 56 Mt of CO_2 to 119 Mt of CO_2. However, with more ambitious policies emissions could fall to 31 Mt of CO_2 under the *Reshape* and 30 Mt of CO_2 under *Reshape+* over the same period.

Across all scenarios for 2015, 2020 and 2030, private vehicles have the highest urban passenger emissions profile. They account for 46% of emissions in the 2015 baseline. In 2030, private vehicles still account for 41-46% of urban passenger emissions. Under Recover, emissions from private vehicles remain at approximately 41% of all emissions for urban transport. However, under Reshape and Reshape+, in addition to the overall shrinking of emissions due to urban transport, private vehicles' share of those emissions falls to approximately 26%.

Figure 20. Urban passenger emissions by mode and scenario for Southeast Asia to 2050



Note: Figure depicts ITF modelled estimates. *Recover*, *Reshape* and *Reshape+* refer to the three scenarios modelled, which represent increasingly ambitious post-pandemic policies to decarbonise transport. Active mobility and micromobility include walking, biking, scooter-sharing, and bikesharing. Public transport includes PT rail, metro, bus, LRT, and BRT. Paratransit includes informal buses and PT three-wheeler. Shared vehicle includes motorcycle and car-sharing. Private Vehicle includes motorcycles and cars. Shared mobility includes taxis, ridesharing, and taxi buses.

Informal public transport has the second-largest emissions share for urban passenger transport in all scenarios for 2015 and 2020. It continues to have the second-highest emissions under the business-as-usual *Recover* scenario in 2030. The high emissions associated with informal public transport can be due to its vehicle fleet not being subject to any standards or emissions requirements. These fleets also tend to be older vehicles. The reduction in emissions associated with informal public transport in the *Reshape* scenarios can be considered both due to the decreased passenger-kilometres conducted by informal public transport but also due to the trips switching to formalised modes, which will be made on cleaner fleets that are likely subject to minimum standards. Vehicle and fuel economy standards will be important to ensure rideshare and public transport vehicles are as low-carbon as they can be. The renewal of the vehicle fleet will be critical to achieving decarbonisation.

A consequence of the fall in emissions from informal public transport is that emissions for shared trips grow considerably under all scenarios between 2015 and 2050 (Figure 20). This can be mainly attributed to the growth in usage for this mode, as more informal public transport modes are formalised and urban transport demand picks up across the board. Under *Recover*, emissions due to shared trips rise 15-fold between 2015 and 2050, reaching 30 Mt of CO_2 in 2050. However, growth for this mode reaches 16 Mt under *Reshape* and 15 Mt under *Reshape+* in 2030, before falling slightly to 14 and 13 Mt, respectively, by 2050.

The age and type of vehicles being used in the various fleets will be very important for controlling emissions given the growth to come in vehicle-based trips in urban transport in Southeast Asia. A tax on CO_2 emissions (carbon tax) per passenger kilometre could play an important role in containing the attractiveness of private vehicle use and of encouraging the renewal of all fleets to more efficient, or electric, vehicles.

Accessibility

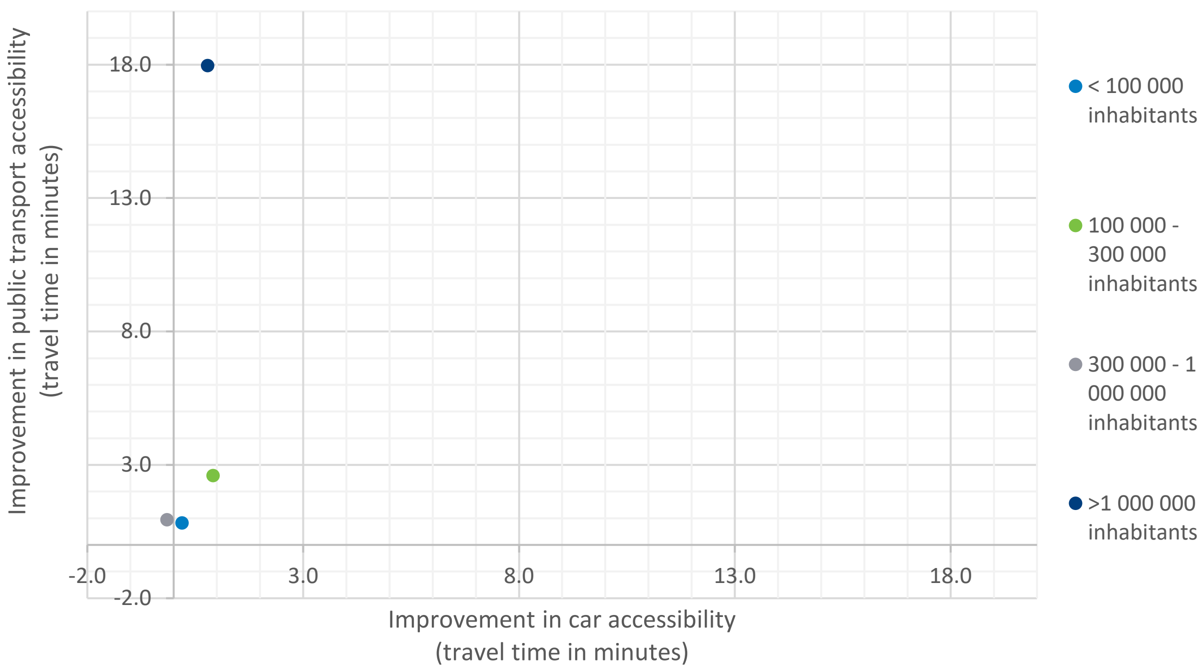
Congestion in urban areas of Southeast Asia is already considered a problem, having consequences for the environment, health and the economy (OECD, 2018b). Manila in the Philippines and Bangkok in Thailand rank among the top ten most congested cities in the world, according to a congestion index compiled by TomTom (TomTom, 2021). Transport policies and urban planning will need to address issues relating to congestion, especially considering the extent of urbanisation expected over the coming years (UN DESA, 2019a) and consequent growth in transport demand.

The public transport systems in many Southeast Asian cities are not sufficient to counteract increasing car ownership and the appeal of private vehicles (including two-wheelers) (The Korea Transport Institute, 2014; OECD, 2018b). Investment in public transport to make it a viable and attractive alternative to private cars is needed to ensure the growth can be accommodated without exacerbating congestion. A previous OECD report that looked at transport in Southeast Asia (OECD, 2018b) found that local authorities or public transport operators are often not in a position to “effectively manage urban transportation issues” (OECD, 2018b, p.24). An ITF Working Group on reforming public transport highlighted the importance of the public sector retaining the power to plan the public transport system, but that the power should be devolved to local governments (ITF, 2020). A regional example of a dedicated transport authority is the Land Transport Authority in Singapore, which is responsible for the planning and delivery of infrastructure and systems for surface transport, including roads, active travel, public transport, taxis and private hire; point-to-point travel options (LTA, 2021).

The growing urban passenger demand will have implications for congestion, which has already been identified as a problem in Southeast Asian cities (ITF, 2017). Congestion, measured as a proportion of the available network capacity that is consumed on average over the day, falls over time in Southeast Asian cities, varying by the size of the city. Among small cities (100 000 inhabitants or fewer), the average proportion of the network consumed by traffic over the course of the day falls by roughly 15 percentage points between 2050 and 2015. For cities with between 100 000 and 300 000 inhabitants, the average use of the network falls dramatically from more than 60% consumption to approximately 4%. Large reductions in capacity consumption are seen in cities with between 300 000 and 1 million inhabitants (approximately 45 percentage points) and cities with over 1 million inhabitants (approximately 29 percentage points). Congestion has implications for local air pollution in addition to CO2 emissions, and policy measures introduced for urban transport should take account of both.

The *Recover*, *Reshape* and *Reshape+* policy scenarios have differing impacts on the public transport and road networks. Figure 21 shows the differences between *Recover* and *Reshape+* by 2050 regarding changes in the average time it takes by either mode to travel from the centre of the city to its edge. Times improve for both cars and public transport accessibility in three of the four city categories, with only cities in the 300 000 to 1 million inhabitants category seeing a decline in accessibility by car, and the second-lowest improvement in public transport. The smallest cities (fewer than 100 000 inhabitants) gain less-than one minute in improvements to public transport accessibility between *Recover* and *Reshape+*. For cities in Southeast Asia, those with over 1 million inhabitants are anticipated to gain the most in public transport accessibility from the more ambitious *Reshape+* policies, with that scenario delivering 18 minutes in improvements to public transport accessibility compared to *Recover*.

Figure 21. Difference in average travel time across the radius of a city in 2050 under the *Reshape+* scenario compared to the *Recover* scenario in Southeast Asia, by car and public transport



Note: Figure depicts ITF modelled estimates. *Recover* and *Reshape+* refer to two scenarios modelled, which represent increasingly ambitious post-pandemic policies to decarbonise transport.

For most city types, the policies of *Reshape+* result in slight improvements in transport affordability, which is measured as a proportion of the available GDP per-capita that is spent on mobility per year. However, in cities with more than 1 million inhabitants, which have naturally higher mobility costs to begin with, there is a small weakening (2.9 percentage points) in the affordability index between *Recover* and *Reshape+*. It is worth noting that the differences between these two scenarios also result in an average 18-minute improvement in the public transport accessibility and a slight improvement in the available mode choices in the network.

Another important metric to consider when looking at affordability changes is the modal mix available in the city. Box 3 describes the methodology for an indicator to assess how dependent an individual would be on a given mode to complete a certain journey. For Southeast Asia, the modal mix does not change much between the different scenarios, however it does change somewhat over time. Overall, the indicator shows an improvement in the modal mix in a city, although the indicator value for shorter trips is reduced in some cities.

The improvement in modal dependency indicator suggests that the modes available to make a trip increase. In particular, the option of shared mobility solutions are expected to increase over time. It is worth noting, however, that as informal modes already exist in response to demand, much increase in shared mobility comes about due to formalisation of informal modes rather than the entry of a new service into the market. The formalisation of modes can also increase the costs to users, affecting affordability, which may in turn impact the availability. As such, the difference in the indicator is less than would be expected in a market, for example, where shared mobility is completely new. However, the formalisation of informal transport can also bring other benefits – such as vehicle standards and improved road safety.

The growth of cities also has an impact on the modal dependency. The indicator suggests that overtime, modal dependency actually dis-improves somewhat for shorter journeys – which typically have a higher mode share for non-motorised modes. This comes about due to the reduction in availability of public transport modes and shared mobility, as they change to serve longer trips as the city footprint grows. This highlights the importance of attractive walking and cycling infrastructure in cities to encourage use of active modes.

Box 3. Measuring systemic modal dependency

The methodological approach for measuring modal dependency in this report is an entropy-based indicator that provides an indication of the diversity and viability of modal alternatives. The following formula represents the indicator structure:

$$EI = -\sum_{i=1}^{k} \frac{p_i \cdot \ln(p_i)}{\ln(k)}$$

where p_k is the proportion of the total realised mobility performed with the k^{th} transport mode type. In this study, available modes are grouped into five categories (k = 5) of transport modes: (1) non-motorised (including micromobility), (2) private vehicles (including but not limited to cars), (3) shared motorised, (4) heavy public transport (i.e. trains, metros/subways, trams, bus rapid transit), (5) light public transport equivalent.

The index measures the viable transport alternatives available to travel in a particular city based on the current conditions and the estimated mobility and mode choice. It is an application of the entropy index used to measure land use mix developed by Potoglou and Kanaroglou (2008), based on Cervero and Kockelman (1997).

0 represents a dependency on a single transport mode, and 1 a uniform distribution between the transport modes.

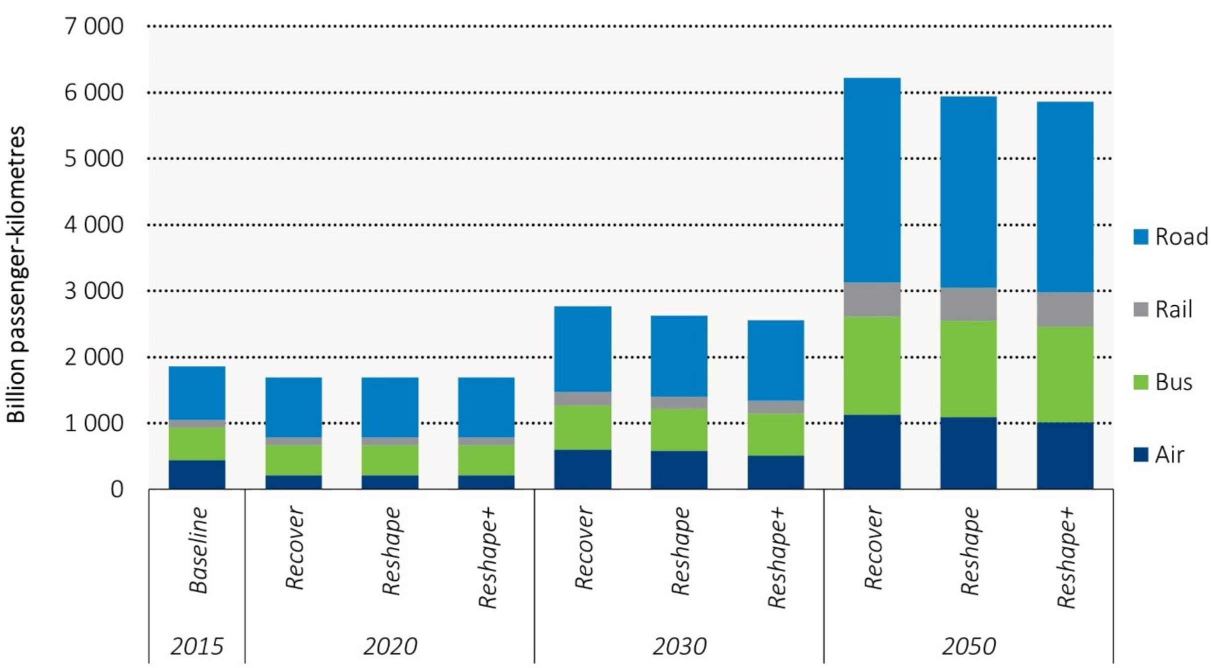
Non-urban passenger transport: Increasing low-emission vehicles and fuels

Non-urban passenger demand is projected to triple between 2015 and 2050 under all three scenarios. Private road transport has the highest mode share for non-urban travel, accounting for approximately 44% in the 2015 baseline. The mode share for private vehicles grows under all three scenarios by 2050, varying between 45% and 50% across the years and scenarios. Non-urban passenger-kilometres by road increase by a factor of 3.8 under *Recover* and by a factor of 3.6 under the *Reshape* scenarios.

Although rail transport is the smallest mode by share of passenger-kilometres, it sees the biggest relative growth between 2015 and 2050. Passenger-kilometres by rail increase by factors of 4.4-4.6 over that time. This is important in light of the planned investment in rail services in Southeast Asia over the coming years (ASEAN Secretariat, 2015b) and the growth in travel expected as the economies of the sub-region grow. Indonesia, Lao People's Democratic Republic (PDR), Myanmar, Philippines, Thailand and Viet Nam have plans to construct or upgrade rail services over the coming years (ASEAN Secretariat, 2015b; ADB, 2021), and these policies and investment will be important in light of an expected increase in rail demand.

The restrictions brought in to cope with the Covid-19 pandemic had a major impact on aviation demand in the sub-region, causing it to half between 2015 and 2020. This resulted in a 44% drop in emissions. In the longer term, air transport recovers and sees passenger-kilometres grow by a factor of between 2.3 and 2.6 between 2015 and 2050. However, this slower growth rate means that overall mode share for air travel falls from 24% to 17% or 18%, depending on the policy measures adopted. Mode share for bus also falls, even though passenger-kilometres almost triple under all scenarios. For surface transport, the rate of growth in bus passenger-kilometres is out-stripped by both road and rail for the sub-region.

Figure 22. Non-urban passenger demand by mode and scenario for Southeast Asia to 2050



Note: Figure depicts ITF modelled estimates. *Recover*, *Reshape* and *Reshape+* refer to the three scenarios modelled, which represent increasingly ambitious post-pandemic policies to decarbonise transport.

Emissions for non-urban passenger transport are set to more than double under the current policy trajectory, seen in the *Recover* scenario (Figure 23). *Recover* reveals emissions rising from 137 Mt in 2015 to 308 Mt in 2050. However, with more ambitious policies emissions fall to 106 Mt under *Reshape* and 103 Mt under *Reshape+*.

Road transport is responsible for more than half of all non-urban emissions for every scenario across all years. By 2050, emissions due to road transport alone under *Recover* grow to such an extent, that at

203 Mt, they are greater than total emissions for all modes of non-urban passenger transport in the baseline year of 2015 (137 Mt CO_2). However, more ambitious policies under *Reshape* and *Reshape+* manage to reduce emissions due to road transport by 2050 (falling to 67 Mt CO_2), after initial growth in emissions through to the mid-2030s.

The next most significant contributor to non-urban passenger emissions is aviation. Air travel constitutes nearly a-third (31%) of emissions from non-urban travel in 2015. Leaving aside the fall due to travel restrictions during the Covid-19 pandemic, air travel's share of emissions under *Recover* stays at approximately 30% through to 2030, when aviation is responsible for 54 Mt of CO_2. After this, aviation emissions begin a gradual fall to 28% of total emissions in 2050, or 86 Mt of CO_2. Under *Reshape,* air-travel emissions fall to 31 Mt and 28 Mt under the *Reshape+*. To achieve the emission reductions seen in *Reshape* and *Reshape+*, uptake of sustainable fuels and (under ambitious scenarios) hybrid planes (some electric charging at airports) or electric planes will be necessary, and policy measures should focus on supporting and encouraging this shift. In the interim, however, these technologies will need to continue to be developed so that they are in a position to be rolled out commercially.

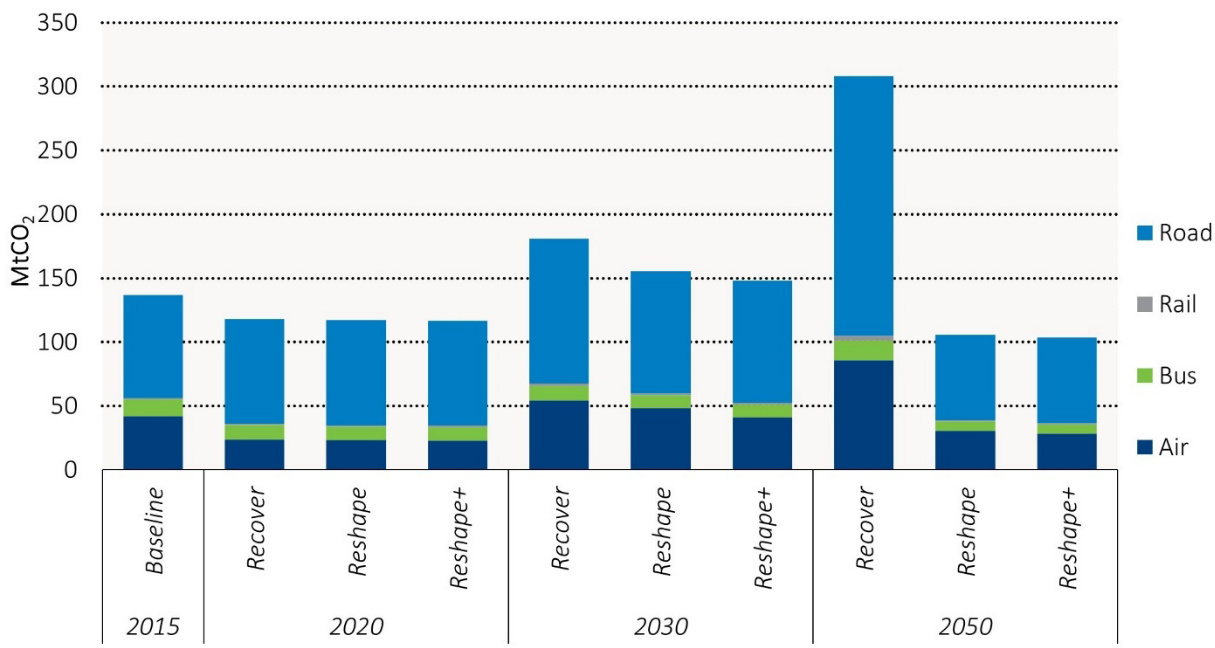
International developments in aviation are being advanced between governments and the International Civil Aviation Organisation (ICAO) (ITF, 2021a). In 2016 ICAO adopted "a basket of measures", including the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) to achieve net-zero emissions growth from aviation after 2020 (ASEAN Secretariat, UN ESCAP and ITF, 2021, p.21). However, these can be supplemented by national, and bilaterally or multilaterally agreed measures to decarbonise the sector. For example, the EU has developed the EU Emissions Trading Scheme (EU ETS), which "is a cap-and-trade mechanism that sets an annual decreasing emissions target and issues emission allowances to regulated entities." (ASEAN Secretariat, UN ESCAP and ITF, 2021a, p.24). An ITF report on decarbonising aviation identified carbon pricing as being "crucial" to decarbonise the aviation sector (ITF, 2021a) and for the level of emissions reductions seen under *Reshape*, carbon pricing schemes would be expected to be introduced.

Emissions from bus and rail also grow under the *Recover* scenario. By 2050, CO_2 emissions from buses will grow by 16 Mt and by 3 Mt for rail. However, under *Reshape* and *Reshape+*, emissions for bus fall to 7 Mt by 2050, over a baseline of 13 Mt in 2015. Rail emissions stay constant at 1 Mt between 2015 and 2050 under the two *Reshape* scenarios, despite passenger-kilometres quadrupling. This can be attributed to an improvement in the rail network and rolling stock, and a move towards electrification of the rail network. It is important to recognise that this is tank-to-wheel (TTW) emissions. Electrification of a rail network results in, on average, a 50% decrease in emissions due to improvements in efficiency of an electric engine over a combustion energy. However, if the electricity to power the network comes from fossil fuels, as is primarily the case in Southeast Asia (IEA, 2019), then there are significant upstream emissions (well-to-tank) to take on board in decarbonisation planning.

For road transport by bus or private vehicles, emissions reductions are expected under *Reshape* and *Reshape+* scenarios, despite the growth in passenger-kilometres. This reduction in emissions relative to *Recover* is especially marked for private road transport. As with urban travel, improvements in the vehicles making the journeys will be important for mitigating the emissions caused by the increased demand. Policy measures will need to focus on improving the efficiency of vehicles encouraging low-carbon fuels and electric vehicles. For light-duty vehicles (LDVs), policies exist or are planned in the sub-region, as highlighted in the ASEAN fuel economy roadmap (ASEAN Secretariat, 2019). All ASEAN Member Countries have agreed a method for measuring tailpipe emissions due to LDVs and all member countries impose some form of limits, although some are still only going as far as the Euro IV standards, which have been superseded twice over by the more stringent Euro V (2009) and Euro VI (2014) standards (ITF, 2022).

The ASEAN roadmap aims to help Southeast Asia's LDV market become "one of the world's most fuel efficient" (ASEAN Secretariat, 2019, p.14). One of the actions is to introduce or strengthen tax measures based on fuel economy or CO_2 emissions. Based on the model outputs in this report, a carbon tax is likely to be necessary to obtain the level of emissions reductions for non-urban travel indicated in the *Reshape* and *Reshape+*. This could be an effective way to encourage the use of more efficient vehicles, both by private individuals and by commercial coach operators. The OECD notes that, as car-ownership is highest among the wealthiest groups, price-based policy measures (in this case on car purchase) "need to be substantial in size to have a significant effect on vehicle ownership" (OECD, 2020, p.27). At a minimum, ITF (2022) recommends removing subsidies for fossil fuels and aligning the taxation policies across the ASEAN member states. Ideally, the taxation policies are recommended to include a carbon tax that increases incrementally over time.

Figure 23. Non-urban passenger emissions by mode and scenario for Southeast Asia to 2050



Note: Figure depicts ITF modelled estimates. *Recover*, *Reshape* and *Reshape+* refer to the three scenarios modelled, which represent increasingly ambitious post-pandemic policies to decarbonise transport.

Conclusions and policy insights

Significant growth is expected in Southeast Asia in the coming decades. This report has analysed different policy scenarios to 2050 for Southeast Asia using the model outputs from the ITF Transport Outlook 2021. This section highlights the key insights offered by this report for policy makers to support transport strategies in the sub-region.

Even under the more ambitious ITF scenarios, transport demand is expected to grow considerably. It is important for the region to adopt policy measures that encourage the most sustainable technologies, vehicles and practices to decarbonise the transport sector and meet commitments under the Paris Agreement and the Sustainable Development Goals. The Covid-19 pandemic has greatly disrupted life in Southeast Asia, as with elsewhere in the world. However, many lessons have also been learned over the course of the pandemic and the actions taken now can help to support a more sustainable recovery for mobility in the context of long-established priorities such as sustainability and connectivity.

Design measures that mitigate the rise of transport emissions as demand grows in Southeast Asia and connectivity improves. The pressing need for economies to recover from the Covid-19 pandemic would suggest a return to demand growth is likely for freight and passenger transport. However, if that growth happens without appropriate mitigation measures, it could impede pre-existing objectives around sustainability and decarbonising transport. If policy approaches return to their business-as-usual approach after the pandemic, this report suggests that emissions due to transport in Southeast Asia would double between 2015 and 2050, with the greatest growth seen in non-urban passenger transport. However, transport sector emissions could fall by up to 40% in total in the sub-region, between 2015 and 2050 if ambitious decarbonisation policies are incorporated into strategies for post-pandemic transport as demonstrated by the *Reshape+* scenario. The results suggest that a combination of policies targeting transport behaviour and technology, following on from the reductions in emissions observed during the pandemic, could reduce emissions from freight and passenger transport by nearly 70% between 2015 and 2050, in Southeast Asia.

Target maritime transport as a critical sector for decarbonising freight transport in Southeast Asia. Freight demand in Southeast Asia is projected to more than triple between 2015 and 2050. Unless this growth and improved connectivity are accompanied by measures to decarbonise, freight emissions will also grow considerably in the same time frame. The most important mode by far for freight in Southeast Asia is sea shipping, which accounts for approximately 90% of freight in the sub-region under all scenarios between 2015 and 2050. Measures such as differentiated port fees can be used to encourage the use of ships with cleaner technology in the region. Slow steaming or speed reductions for ships would be expected to have a considerable impact in reducing emissions by reducing the carbon intensity of shipping.

Improved vehicle technologies will be important for decarbonising road transport as demand increases. In terms of emissions, road freight in Southeast Asia causes greater emissions than shipping, despite carrying fewer tonne-kilometres. Road freight represents between 7% and 9.4% of non-urban tonne-kilometres, but between 45% and 60% of non-urban freight emissions to 2050. It is not only road freight where road vehicle fleets need to be improved. The least polluting vehicles should be used in all sectors and modes. For non-urban passenger travel, road vehicles (both private and bus or coach) account for over 70% of passenger-kilometres in 2015 and will continue to do so into the future. These vehicles account for between 68% and 79% of emissions from non-urban passenger travel in Southeast Asia, varying by year and scenario. For urban passenger transport, private vehicles (including cars and motorcycles) also roughly retain their share of passenger-kilometres, (slightly over a-third) between 2015 and 2050, but under the *Recover* scenario, private vehicles are expected to contribute nearly half of all urban passenger transport emissions to 2050. Much of the demand growth in urban passenger transport is also expected to go to informal transport and shared trips or shared vehicles. Collectively these make up more than 80% of emissions due to urban passenger-kilometres in the 2015 baseline and under the *Recover* scenario in 2050. Even under the *Reshape* and *Reshape+* scenarios, these modes combined are responsible for approximately 75% of emissions from urban passenger transport in 2050. In all cases, the vehicles in the fleets will be critical to reducing emissions.

Clearly, road vehicles will remain an important part of the modal mix so ensuring that they are as low-carbon as possible is important to support sustainable growth. Policies that encourage the uptake of low- and zero-emissions vehicles, and thus generate the renewal of the fleets are extremely important for both urban and freight transport. Implementation of fuel economy standards (ITF, 2022), vehicle standards and promotion of alternative fuels or electric vehicles as appropriate will be needed.

For freight transport, in the long term, an energy transition for long-haul, heavy-duty road freight will be needed. Under the *Reshape* and *Reshape+* scenarios, it would be expected that alternative fuels or power sources would be prevalent in the road freight sector by 2050. In the shorter term, permitting high capacity vehicles could increase load-factors and reduce vehicle kilometres. Future trade agreements could be an important tool in standardising vehicle requirements in the region.

Low- or zero-emission vehicles will be critical for decarbonising urban freight. Rapid urbanisation in most countries in Southeast Asia means that urban freight movements also remain a major challenge for freight transport, contributing to urban pollution and congestion. In addition, rising e-commerce has further increased freight vehicles in urban areas, straining already stressed urban transport infrastructure. Vehicle congestion is acute in most cities of the sub-region, leading to a decrease in productivity from lost time, wasted fuel and increased costs of doing business. The involvement of multiple stakeholders could complicate efforts to address urban freight challenges in the sub-region. There are various ways to improve urban freight transport and plans for urban freight should be considered in urban transport strategies for the future.

Electrification of rail can reduce trip-based emissions through efficiency improvements. Rail and inland waterways are also used for freight in Southeast Asia, and tonne kilometres for both modes grow between 2015 and 2050. Several countries have significant rail investments planned in the coming years. These major developments in rail networks will improve connectivity between countries as well as within them. The electrification of existing and new rail networks would reduce emissions, making rail connectivity even more sustainable. Emissions would be even lower with the transition to more sustainable energy production upstream – moving away from fossil fuel sources for electricity production. Improving intermodal interfaces is also needed to improve the efficiency of freight movements and reduce the time penalties associated with interchange to rail or river freight.

Improve cross-border trade facilitation to enhance connectivity. Uneven transport connectivity within the sub-region and with other sub-regions also remains an outstanding concern for Southeast Asia. Complicated border crossing formalities increase transit and transport costs leading to loss of competitiveness of the countries of the sub-region. Most countries do not grant traffic rights and rely on inefficient transshipment processes at the borders to move the freight. Future trade regionalisation would be expected to impact freight emissions as distances between origins and destinations in the one of the regions would be shorter.

During the Covid-19 pandemic, the need to keep freight flowing became pressing for the economies of the sub-region and some lessons can be learned from this (ASEAN Secretariat, UN ESCAP and ITF, 2021). After initial restrictions on the movement of goods and people, efforts were made to improve trade facilitation, such as agreeing new procedures and digitalisation of documents (ASEAN Secretariat, UN ESCAP and ITF, 2021). The digitalisation of documents to aid tracking and border crossings for freight, for example, is also consistent with long-term strategic goals of improving trade facilitation between countries in the sub-region, and between the sub-region and other countries. Digital logistics platforms are developing to more efficiently share information among various logistics stakeholders to reduce cost, and electronic cargo tracking systems are being used to facilitate transiting transport. Measures to improve the efficiency of freight would be helpful to decarbonise the sector. In particular, adopting asset sharing could be pursued through increased digitalisation of freight logistics management under digitalisation strategies in the sub-region.

Accelerate aviation's technology and fuel transition to reduce emissions. Given the geographic nature of Southeast Asia, and the importance of tourism to many of the economies in the sub-region, aviation is an important sector for both goods and people movement. This is expected to remain the case as the economies of the sub-region grow. This sector was heavily impacted by the restrictions introduced to manage the Covid-19 pandemic between the model category years of 2015 and 2020. As such, decarbonisation of this sector will be crucial to reduce emissions due to transport in Southeast Asia.

Alternative aviation technology will be needed to prevent emissions growing with increased demand. Aviation was the non-urban mode that saw the greatest reduction in demand during the pandemic. However, this contributed to a reduction in emissions too. All three scenarios, *Recover*, *Reshape* and *Reshape+*, see a growth in emissions due to aviation after 2020, but this is significantly lower under *Reshape* as it is assumed that aviation technology improves to reduce the emissions per passenger-kilometre. Under *Recover*, aviation emissions are due to more than double for passenger transport and increase by more than 60% for freight. Development and uptake of sustainable alternative fuels or electric planes is needed to achieve the significant reductions in emissions seen under *Reshape* compared to the baseline *Recover* scenario. This help to mitigate the emissions from the increased air travel demand for both passengers and freight.

Measures to support the uptake of sustainable alternative fuels (SAFs) for aviation could include fuel blending mandates. These require a minimum proportion of total fuel used to be SAFs, with the minimum proportions of SAF stipulated progressively increasing. Development of new hybrid-electric planes and a more extensive range of electric planes, can also support the decarbonisation of aviation, provided the cost compared to conventional aviation also falls. A carbon-pricing solution would be expected to play a very important role in achieving the desired level of emissions reductions.

Leverage decarbonisation opportunities offered by urban transport. Urbanisation is expected to continue in Southeast Asia and requires strategic and integrated advanced planning to ensure the development of liveable cities. The urban population of Southeast Asia is expected to continue growing over the coming decades. By 2050, the proportion of the population that is living in urban areas is expected to be 66%, compared to 49% in 2018 (UN DESA, 2019c). Passenger travel demand will more than triple between 2015 and 2050 according to ITF modelling and congestion is already a problem in the sub-region (OECD, 2018b). Comprehensive strategies for mobility are needed to ensure that the growth in inhabitants and travel can be sustainably accommodated. The *Reshape* and *Reshape+* scenarios assume that policies that will be introduced will enable positive changes in travel behaviour. The key will be to ensure that as demand grows again, transport users will be choosing sustainable modes rather than private vehicles. Measures to improve the energy efficiency of vehicle fleet and those to reduce the use of private cars can also have benefits related to reducing both local pollutant and CO_2 emissions due to transport.

Improving public transport is important to ensure it is more attractive and offers a viable alternative to private cars. Reliable and frequent services that are easily accessible are needed. The vehicle fleets used for the public transport should also be low- or zero-emission. Other modes, without fixed routes, could also be used to improve accessibility and make sustainable mobility easy and attractive. App-based mobility services could formalise informal public transport modes into more on-demand modes, which would be expected to improve the standards of the vehicles being used. Several regulatory actions are recommended by ITF (forthcoming b) to encourage this development in a way that supports policy outcomes, including outcome-based regulation to remove regulatory grey-areas, improved co-ordination between responsible ministries, appropriate data governance and corresponding capacity to manage data.

The promotion of active modes of transport, such as walking and cycling, will also help to keep emissions down. Cities are expected to increase their footprints due to urbanisation – thus risking an increasing number of trips becoming too long to be feasible or appealing by active modes. Urban design can support access to essential services on foot or bicycle or ensure that developments have viable sustainable mobility options available. Integrated land-use and transport planning in anticipation of urbanisation is important to create liveable and sustainable cities in the future.

Notes

1 “The Liner Shipping Connectivity Index captures how well countries are connected to global shipping networks. It is computed by the United Nations Conference on Trade and Development (UNCTAD) based on five components of the maritime transport sector: number of ships, their container-carrying capacity, maximum vessel size, number of services, and number of companies that deploy container ships in a country's ports. For each component a country's value is divided by the maximum value of each component in 2004, the five components are averaged for each country, and the average is divided by the maximum average for 2004 and multiplied by 100. The index generates a value of 100 for the country with the highest average index in 2004. The underlying data come from Containerisation International Online.” (World Bank, No Date)

2 “Doing Business records the time and cost associated with the logistical process of exporting and importing goods. Doing Business measures the time and cost (excluding tariffs) associated with three sets of procedures—documentary compliance, border compliance and domestic transport—within the overall process of exporting or importing a shipment of goods… The ranking of economies on the ease of trading across borders is determined by sorting their scores for trading across borders. These scores are the simple average of the scores for the time and cost for documentary compliance and border compliance to export and import.” (World Bank Group, 2021b)

3 Asia as a whole is the region with the highest absolute tonne-kilometres of freight in the world according the ITF Transport Outlook 2021 (OECD/ITF, 2021). However, in terms of the rate at which the tonne-kilometres grow relative to their 2015 levels, Southeast Asia’s volumes are anticipated to grow more quickly compared to 2015 than other world regions as reported in the ITF Transport Outlook 2021.

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Annex A. *ITF Transport Outlook 2021* modelling scenarios: *Recover, Reshape, Reshape+*

The following text was taken from the ITF Transport Outlook 2021, (ITF, 2021e, p.55-56). The modelling results for the present report were based on the scenarios described below.

The *Recover*, *Reshape* and *Reshape+* scenarios assess the impacts of different policy pathways on global transport demand, greenhouse gas emissions (reported as CO_2 equivalents), local pollutant emissions, accessibility, connectivity and resilience (depending on the sector) up to 2050. The emissions are based on transport activity and do not include emissions from vehicle production or construction and operation of transport infrastructure.

The three scenarios represent increasingly ambitious efforts by policy makers to decarbonise the transport sector while also meeting the UN Sustainable Development Goals (SDGs). All scenarios account for the Covid-19 pandemic by including the same baseline economic assumptions for the pandemic's impacts. Uncertainty surrounds its economic fallout, the behavioural shifts it may trigger, and the extent to which it will affect transport supply and travel patterns both in the long and short term. The ITF models use middle of the road assumptions that lie somewhere between the most optimistic and most pessimistic forecasts available at the time of modelling.

For GDP and trade in 2020, the ITF models assume a drop in all world regions, based on the International Monetary Fund's World Economic Outlook June update (IMF, 2020) and the World Trade Organization's Trade Statistics and Outlook (WTO, 2020) applied to baseline GDP and trade values from the OECD ENV-Linkages model (OECD, 2020). Following years assume the previous country-specific growth rates after 2020. This is approximated by a five-year delay in GDP and trade projections compared to pre-Covid-19 levels from 2020. Assumptions of economic activity and trade are held constant between all scenarios to better compare the true transport policy impact on activity, CO_2 emissions and other outcomes. Air connectivity growth is also adjusted to account for the severity of the pandemic's impact on aviation. For 2020, ITF models assume a drop in flight frequencies and pre-Covid-19 growth rates to meet the projections for 2025 by the International Air Transport Association (IATA, 2020).

In *Recover*, governments prioritise economic recovery by reinforcing established economic activities. They continue to pursue existing (or imminent) commitments to decarbonise the transport sector, predating the pandemic. Alongside these, governments take action with policies that ensure some of the transport trends that hinder decarbonisation observed during Covid-19 revert back to previous patterns by 2030, as a bare minimum. These include reversing trends in greater private car use and reducing public transport ridership, for example. Changes in behaviour such as reduced business travel or significant shifts to active mobility, which have lowered CO_2 emissions, also revert to pre-pandemic norms by 2030. Due to limited policy action on technology innovation, cost reduction in clean energy and transport technologies does not take place to the extent it could. The Recover scenario is an updated version of the Current Ambition scenario in the ITF Transport Outlook 2019, accounting for Covid-19 related changes and policies announced since.

The *Reshape* scenario represents a paradigm shift for transport. Governments adopt transformational transport decarbonisation policies in the post-pandemic era. These encourage changes in the behaviour of transport users, uptake of cleaner energy and vehicle technologies, digitalisation to improve transport efficiency, and infrastructure investment to help meet environmental and social development goals. As in

Recover, the *Reshape* scenario also assumes that transport trends and patterns observed during the pandemic revert to previous patterns by 2030.

In *Reshape+*, governments seize decarbonisation opportunities created by the pandemic, which reinforce the policy efforts in Reshape. Measures reinforce changes in travel behaviour observed during the pandemic, such as reducing business travel or encouraging walking and cycling. Some of these policies are fast-tracked or implemented more forcefully than in Reshape. The scenario assumptions also include pandemic impacts on non-transport sectors that may nevertheless influence transport, for instance, a regionalisation of trade due to near-sourcing to improve resilience. Under *Reshape+*, CO_2 emission targets for the transport sector can be achieved sooner and with more certainty and with less reliance on CO_2 mitigation technologies whose efficacy is still uncertain.

The *Reshape* and *Reshape+* scenarios show what is possible with technologies and policies available today, but with increased investments and more political ambition. The policies act additively, meaning that while there are adjustments made for regions, most policies are applied to most regions with some adjustment for regional contexts. Results are not prescriptive in assigning certain combinations of measures to specific regions. The results show what is technically feasible under full implementation. Still, it is recognised that there may be political and financial constraints that require prioritisation of measures depending on local contexts. The policy scenarios show what may happen at a global and regional level under a set of policies to manage transport demand, shift to more sustainable modes, and improve the energy efficiency of vehicles and fuels.

There are many modelling approaches to assess necessary actions for decarbonisation. The ITF models are demand-based and favour a bottom-up approach which starts with potential policy scenarios and evaluates resulting activity and CO_2 emissions. Other useful modelling exercises such as backcasting from a specific goal offers a different set of advantages and drawbacks. Backcasting starts with a goal and works backwards to see where demand and technologies must be to meet such a goal. The ITF favours the current method over backcasting because it allows for creating the most realistic, and therefore relevant scenarios. The current lack of data available to determine regional and sectoral goals across the globe means that selecting a realistic scenario that reflects the unique constraints of every region is not possible.

Annex B. Freight transport scenario specifications from the *ITF Transport Outlook 2021*

The following text was taken from the ITF Transport Outlook 2021, (ITF, 2021e, p.184-186). Shading denotes policies with stronger implementation in *Reshape+*

Measure/ Exogenous factor	Description	*Recover*	*Reshape*	*Reshape+*
Economic Instruments				
Distance charges	Distance based charges for road freight.	Charges introduced in 2030 growing to 1 cent per tonne-kilometre by 2050.	Charges introduced in 2030 growing to 2.5 cents per tonne-kilometre by 2050.	Charges introduced in 2025 growing to 6 cents per tonne-kilometre by 2050.
Port fees	Differentiated port fees depending on environmental performance of vessels, i.e. ships with no clean technologies have higher port fees.	Port fees grow an additional 1% by 2050 decreasing the carbon intensity of shipping by 0.5%.	Port fees grow an additional 20% by 2050 decreasing the carbon intensity of shipping by 10%.	Port fees grow an additional 30% by 2050 decreasing the carbon intensity of shipping by 15%.
Carbon pricing	Pricing of carbon-based fuels based on the emissions they produce.	Carbon pricing varies across regions: USD 150- 250 per tonne of CO_2 in 2050.	Carbon pricing varies across regions: USD 300-500 per tonne of CO_2 in 2050.	
Enhancement of infrastructure				
Rail and inland waterways improvements	Increase in attractiveness of intermodal solutions, namely trips with a rail or inland waterway component.	The penalty for mode transfers at intermodal terminals is decreased and alternative specific constant of rail and inland waterways increases. The rate of change varies by world region, e.g. in Western Europe it grows from 2% in 2020 to 20% in 2050.	The penalty for mode transfers at intermodal terminals is decreased and alternative specific constant of rail and inland waterways increases. The rate of change varies by world region, e.g. in Western Europe it grows from 4% in 2020 to 40% in 2050.	The penalty for mode transfers at intermodal terminals is decreased and alternative specific constant of rail and inland waterways increases. The rate of change varies by world region, e.g. in Western Europe it grows from 10% in 2020 to 80% in 2050.
Transport network improvement plans	Construction and upgrade of new infrastructure, e.g. new roads, railways or port expansion.	The transport network is updated with planned new infrastructure and upgrades (e.g. increases in port capacity, developments in Central Asia, TEN-T European projects) expected to become operational between 2020 and 2050.		
Energy transition for long-haul heavy-duty road freight vehicles	Includes a range of solutions to achieve zero emissions for long haul heavy duty road vehicles, including: Electric Roads (ERS), hydrogen fuel cells, advanced batteries, or low carbon fuels (for more check (ITF, 2019[1]))	Very low, marginal implementation	14% of heavy trucks tkm are on these systems by 2050. Costs begin higher than conventional fuels but by 2050 become lower. Differences in uptakes and costs by regions.	37% of heavy trucks tkm are on these systems by 2050. Costs begin higher than conventional fuels but by 2050 become lower. Differences in uptakes and costs by regions.

Measure/ Exogenous factor	Description	*Recover*	*Reshape*	*Reshape+*
Operations management				
Asset sharing and the Physical Internet	Sharing assets (e.g. vehicles or warehouses) to make resource management for logistics activities more efficient.	Less than 1% Increase in average loads of road freight by 2020 growing to 2% in 2050.	4% Increase in average loads of road freight by 2020 growing to 10% in 2050.	Less than 4% Increase in average loads of road freight in 2020 growing to 20% in 2050. Accelerated increase between 2020 and 2030.
Regulatory instruments				
Slow steaming and speed reduction for maritime and trucks	Reduction of the average speed of ships or trucks to reduce emissions.	Decrease in the speed of road and maritime transport is less than 1% in 2020, growing to a 10% decrease by 2050.	Decrease in the speed of road and maritime transport is 1% in 2020, growing to a 20% decrease by 2050.	Decrease in the speed of Road and Maritime modes by more than 1% in 2020, growing to a 33% decrease by 2050.
Fuel economy standards for internal combustion engine (ICE) vehicles and fuel	Increase in fuel efficiency of ICE road freight vehicles.	Carbon intensity per tkm of ICE trucks reduces by less than 1% in 2020 up to 10% by 2020.		Carbon intensity per tkm of ICE trucks reduces by 2% in 2020 up to 15% by 2020.
Low emission fuel incentives (including electric vehicles) and investment in distribution/supply infrastructure	Increases the share of low emission vehicles km (e.g. electric, hydrogen, clean biofuels, biogas) in commercial vehicle fleets, lowering the average carbon intensity of road freight.	Increases in low emission fuels vehicle shares vary by world-region, in faster adoption regions (e.g. Western Europe) there is an increase of 1% by 2025, growing to 10% by 2050.	Increases in low emission fuels vehicle shares vary by world-region, in faster adoption regions (e.g. Western Europe) there is an increase of 2.6% by 2025, growing to 20% by 2050.	Increases in low emission fuels vehicle shares vary by world-region, in faster adoption regions (e.g. Western Europe) there is an increase of 4% by 2025, growing to 30% by 2050.
Heavy Capacity Vehicles (HCV)	Road vehicles that exceed the general weight and dimension limitations set by national regulations. Truck loads increase 50% and costs fall 20% per tonne-kilometre where HCVs are adopted.	By 2050 2% of non-urban road freight transport activity (tkm) is done with high capacity vehicles.	By 2050 5% of non-urban road freight transport activity (tkm) is done with high capacity vehicles.	By 2050 10% of non-urban road freight transport activity (tkm) is done with high capacity vehicles.
Stimulation of innovation and development				
Autonomous Vehicles and Platooning	Simulates the adoption of autonomous trucks (platooning and full autonomy) in road freight. The adoption of this technology reduces costs for road freight, but also its CO_2 intensity, on the other hand it can induce demand and reverse modal shift.	Adoption varies by sector (urban and non-Urban) and world-region. Very low to marginal adoption in this scenario.	Up to 45% uptake on non-urban in some regions by 2050 (Europe, North America, China, Japan and South Korea). Uptake on urban freight is lower. Decrease of 14% on carbon intensity and 45% on costs.	Up to 90% uptake on non-urban in some regions by 2050 (Europe, North America, China, Japan and South Korea). Uptake on urban freight is lower. Decrease of 14% on carbon intensity and 45% on costs.
Electric/alternative fuel vehicle penetration and increases in efficiency for all transport modes	Electric/alternative fuel vehicle penetration and increases in efficiency for all transport modes (including average loads and vehicle capacity).	Follows the IEA STEPS Scenario.	Follows the IEA SDS Scenario.	

Measure/ Exogenous factor	Description	*Recover*	*Reshape*	*Reshape+*
Intelligent Transport Systems (ITS) and eco-driving	Development of ITS to provide better quality, real-time, automatic data collection and processing to improve fleet management, routing and assist driving.	Implemented with regional variations, in regions with faster deployment (e.g. Western Europe) reductions of 4% in carbon intensity in 2020 and close to zero in 2050.	Implemented with regional variations, in regions with faster deployment (e.g. Western Europe) reductions of 10% in carbon intensity in 2020 and 1% in 2050.	Implemented with regional variations, in regions with faster deployment (e.g. Western Europe) reductions of 15% in carbon intensity in 2020 and close to 2% in 2050.
Exogenous factors				
3D Printing	Enables manufacturing closer to the point of consumption, leading to drop in long distance trade for several commodities compared to estimated values, namely manufactured goods.	Negligible impact on trade.	International trade shrinks 10% by 2050. Values differ by commodities, electronic and manufactured goods have higher falls.	
Decarbonisation of energy	Decreases in trade and consumption of oil and coal as societies decarbonise, directly impacting freight transport demand for fossil fuels.	Oil and Coal grow less than other commodities (following ENV-Linkages model (ENV-OECD), (Chateau, Dellink and Lanzi, 2014)	Yearly decrease of 3.35% for coal and 2.1% for oil. By 2050 coal trade has reduced 65% and oil close to 50%, compared to 2020 estimates.	Yearly decrease of 10% for coal and 2.1% for oil. By 2050 coal trade has reduced by 96% being almost phased-out globally and there is close to a 50% decrease in oil consumption compared to 2020 estimates.
Trade regionalisation	Simulates increased trade exchanges within regions or trade blocks, while decreasing longer distance trade between regions.	No additional fees compared to baseline.		5% increase in penalty fees for intra-regional trade.
E-commerce	Simulates the impact of growth in e-commerce and home deliveries. Increases the estimated demand of goods over time in addition to the projected values.	Urban freight with an additional 5% demand increase by 2050, smaller impacts on non-urban freight.		

Note: There is an overlap between the "Energy transition for long-haul heavy-duty road freight vehicles", "Low emission fuel incentives (including electric vehicles) and investment in distribution/supply infrastructure" and "Electric/alternative fuel vehicle penetration" measures. But they apply differently to different regions of the world and vehicle types, the adoption rate implemented in the scenario matches the highest value between this three measures for each world region and vehicle type/operation.

Source: ITF (2021, p.184-186)

Annex C. Urban passenger transport scenario specifications from the *ITF Transport Outlook 2021*

The following text was taken from the ITF Transport Outlook 2021, (ITF, 2021e, p. 93-95). Shading denotes policies with stronger implementation in *Reshape+*

Measure/Exogenous factor	Description	*Recover*	*Reshape*	*Reshape+*
Economic instruments				
Carbon pricing	Pricing of carbon-based fuels based on the emissions they produce.	Carbon pricing varies across regions: USD 150-250 per tonne of CO_2 in 2050	Carbon pricing varies across regions: USD 300-500 per tonne of CO_2 in 2050	
Road pricing	Charges applied to motorised vehicles for the use of road infrastructure.	0% to 7.5% increase of non-energy related car use costs by 2050, half for motorcycles.	2.5% to 25% increase of non-energy related car use costs by 2050, half for motorcycles.	
Parking pricing and restrictions	Regulations to control the availability and price of parking spaces for motorised vehicles.	5% to 50% of a city area subject to parking constraints, and 0% to 60% increase in parking prices by 2050.	7% to 75% of a city area subject to parking constraints and 20% to 150% increase in parking prices by 2050.	
Enhancement of Infrastructure				
Land-use planning	Densification of cities.	Density variation of -10% to +20% for the city centre of urban areas over 300 000 inhabitants. Density variation of -10% to +10% for cities under 300 000 inhabitants and for suburbs of urban areas over 300 000 inhabitants.	Density variation of 0% to +40% for the city centre of urban areas over 300 000 inhabitants. Density variation of 0% to +20% for cities under 300 000 inhabitants and for suburbs of urban areas over 300 000 inhabitants.	
Transit-Oriented Development (TOD)	Increase in mixed-use development in neighbourhoods around public transport hubs.	Increases the land-use diversity mix and increases the accessibility to public transit by 5% by 2050.	Increases the land-use diversity mix and increases the accessibility to public transit by 7.5% by 2050.	Increases the land-use diversity mix and increases the accessibility to public transit by 10% by 2050.
Public transport priority measures and express lanes	Prioritising circulation of public transport vehicles in traffic through signal priority or express lanes.	0% to 40% of bus, light rail transit and bus rapid transit network prioritised by 2050.	10% to 60% of surface public transport network prioritised by 2050.	
Public transport service improvements	Improvements to public transport service frequency and capacity.	-10% to +10% service improvement for rail or corridor based public transport systems resulting in a -1% to +1% speed variation by 2050. 10% to 30% service improvement for bus and paratransit transport systems resulting in a 0.25% to 0.7% speed variation by 2050.	10% to 15% service improvement for rail or corridor based public transport systems resulting in a 1% to 1.5% speed variation by 2050. 20% to 50% service improvement for bus and informal public transport systems resulting in a 0.5% to 1.25% speed variation by 2050.	

Measure/Exogenous factor	Description	*Recover*	*Reshape*	*Reshape+*
Public transport infrastructure improvements	Improvements to public transport network density and size.	0% to 100% growth increase for the public transport network by 2050.	0% to 200% growth increase for the public transport network by 2050.	
Integrated public transport ticketing	Integration of public transport ticketing systems.	1.5% to 4.5% reduction of a public transport ticket cost, and 2.5% to 7.5% reduction of public transport monthly subscription cost by 2050.	1.5% to 7.5% reduction of a public transport ticket cost, and 2.5% to 12.5% of public transport monthly subscription cost by 2050.	
Bike and Pedestrian infrastructure improvements	Increase in dedicated infrastructure for active mobility.	20% to 300% increase in road space available to active modes by 2050 and a simultaneous increase in the speed of active modes, including micromobility	40% to 500% increase in road space available to active modes by 2050 and a simultaneous increase in the speed of active modes, including micromobility.	50% to 600% increase in road space available to active modes by 2050 and a simultaneous increase in the speed of active modes, including micromobility.
Speed limitations	Traffic calming measure to reduce speed and dominance of motor vehicles through low-speed zones or infrastructure.	2% to 30% reduction of speed on main roads, by 2050	5% to 50% reduction of speed on main roads, by 2050	
		Regulatory instruments		
Urban vehicle restriction scheme	Car restriction policies in certain areas and during certain times to limit congestion. Typically applied in the city centre.	0% to 17.5% reduction of car ownership by 2050, Reduction of the car and carsharing speeds while increasing the car and motorcycle access time.	3.5% to 25% reduction of car ownership by 2050, Reduction of the car and carsharing speeds while increasing the car and motorcycle access time.	
Low-emission vehicles incentives and infrastructure investment	Financial incentives for the purchase and use of alternative fuel vehicles and investment in charging infrastructure.	Decreases average vehicle-kilometres made with diesel, gasoline and methane fuels between 0% and 4% by 2050.	Decreases average vehicle-kilometres made with diesel, gasoline and methane fuels between 0% and 36% by 2050.	Decreases average vehicle-kilometres made with diesel, gasoline and methane fuels between 0% and 45% by 2050.
		Stimulation of innovation and development		
Electric/alternative fuel vehicle penetration	Degree of uptake of electric/alternative vehicles in an urban vehicle fleet	Follows the IEA STEPS Scenario	Follows the IEA SDS Scenario	
Carsharing incentives	Incentives to encourage car rental schemes where members have access to a pool of cars as needed, lowering car ownership	0% to 15% increase in shared car availability per capita, and 0% to 40% increase in shared motorcycle availability per capita, by 2050.	5% to 30% increase in shared car availability per capita, and 10% to 60% increase in shared motorcycle availability per capita, by 2050.	
Carpooling policies	Carpooling policies encourage consolidating private vehicle trips with similar origins and destinations.	3.5% to 8.3% increase in average load factor by 2050.	7.6% to 16.7% increase in average load factor by 2050.	
Ridesharing/shared mobility	Increased ridership in non-urban road transport (car & bus)	25% to 200% increase of ridesharing vehicles per capita growth by 2050. Load factor evolution from -50% to +25% by 2050.	25% to 300% increase of ridesharing vehicles per capita growth by 2050. Load factor increase from 0% to 100% by 2050.	

Measure/Exogenous factor	Description	*Recover*	*Reshape*	*Reshape+*
Mobility as a Service (MaaS) and multimodal travel services	Improved integration between public transport and shared mobility (app integration, as well as physical infrastructure, ticketing and schedule integration). Increase in availability and load factors of shared mobility	1.7% to 10% reduction of a public transport ticket cost, and 1.0% to 6.0% reduction of shared mobility cost by 2050. Increase in the number of shared mobility vehicles and stations	3.3% to 20% reduction of a public transport ticket cost, and 2.0% to 12.0% reduction of shared mobility cost by 2050. Significant increase in the number of shared mobility vehicles and stations	
Exogenous factors				
Autonomous vehicles*	Introduction of vehicles with level 5 autonomous capabilities	The percentage of autonomous vehicles in use varies across regions: for car 0% to 3%, for bus 0% to 1.5%, for shared vehicles 0% to 6%.		
Teleworking	Reduces business and commuting trips, while increasing short non-work trips.	2.5% to 20% of the active population could telework by 2050.	3.5% to 30% of the active population could telework by 2050.	5% to 40% of the active population could telework by 2050.

Note: Range of values reflect the varying degrees of implementation of policy measures across the different world regions in each scenario. Unless otherwise specified, a % change indicates an alteration of a certain variable in a given year compared to the absence of a policy. For example, PT ticket costs are endogenously calculated for each city and year by the model, indexed to GDP, assuming no policy action. An X% decrease would be applied to the ticket price of the specific city and year.*Autonomous vehicles are considered but are not a primary factor in any of the scenarios. All scenarios assume a constant level of introduction of vehicles with Level 5 autonomy. The *ITF Transport Outlook 2019* focussed more specifically on transport disruptions, including autonomous vehicles, and assessed related scenarios.

Source: extract from ITF (2021) Transport Outlook 2021, Table 3.3, p. 93-95

Annex D. Non-urban passenger transport scenario specifications from the *ITF Transport Outlook 2021*

The following text was taken from the ITF Transport Outlook 2021, (ITF, 2021e, p. p.142-144). Shading denotes policies with stronger implementation in *Reshape+*

Measure/Exogenous factor	Description	*Recover*	*Reshape*	*Reshape+*
Economic instruments				
Ticket taxes (air travel)	Percentage tax applied on the cost of airfare	Ticket taxes vary across regions: 3% - 15% in 2050	Ticket taxes vary across regions: 8% - 30% in 2050	
Carbon pricing	Charges applied on tailpipe CO_2 emissions	Carbon pricing varies across regions: USD 150-250 per tonne of CO_2 in 2050	Carbon pricing varies across regions: USD 300-500 per tonne of CO_2 in 2050	
Enhancement of infrastructure				
Development of ultra-high-speed rail	Introduction of new ultra-high-speed rail routes, such as Maglev	No development of new ultra-high-speed rail	Development of Maglev routes where economically feasible	
Improvements in rail infrastructure	Investments in existing rail infrastructures leading to frequency and speed increases	Frequency increases by 50% (year of improvement varies across regions)	Frequency (50%) and speed (20%) improvements across regions	Earlier frequency (50%) and speed (20%) improvements across regions
Regulatory instruments				
Synthetic fuels (aviation)	Decrease of synthetic aviation fuel cost relative to conventional fuel as a result of technological developments	Synthetic fuels cost is 3.3 times more expensive than conventional fuel	Synthetic fuels cost is three times more expensive than conventional fuel	
Mandates in aviation for sustainable aviation fuels (SAF)	SAF should constitute a minimum percentage of total fuel used	Minimum SAF percentage varies across regions 5% - 10% in 2050	Minimum SAF percentage varies across regions 10% - 25% in 2050	Minimum SAF percentage varies across regions 15% - 30% in 2050
Operational instruments				
Optimise aircraft movements	Flights are closer aligned to greater circle paths	Deviations are reduced by 50% in 2030	Deviations are reduced by 50% in 2020	
Simulation of innovation and development				
Electric/alternative fuel vehicle penetration	Increased penetration of electric vehicles in non-urban road transport due to financial incentives for the purchase and use of alternative fuel vehicles and investment in charging infrastructure.	Follows the IEA STEPS Scenario	Follows the IEA SDS Scenario	Increased penetration on top of IEAs SDS Scenario

<table>
<tr><th>Measure/Exogenous factor</th><th>Description</th><th>Recover</th><th>Reshape</th><th>Reshape+</th></tr>
<tr><td>Hybrid-electric planes</td><td>Development of new hybrid-electric aircraft.</td><td>Hybrid-electric aircraft are available from the year 2030.
They provide 5% - 7.5% of total energy required reaching up to 20% - 30% in 2050 depending on the region.</td><td colspan="2">Hybrid-electric aircraft are available from the year 2030.
They provide 7.5% - 10% of the total energy required reaching up to 30% - 40% in 2050 depending on the region.</td></tr>
<tr><td>Ridesharing/shared mobility</td><td>Increased ridership in non-urban road transport (car and bus)</td><td>The percentage of shared trips of total trips by car equals 6.7%</td><td colspan="2">The percentage of shared trips of total trips by car varies across regions
13.3% – 20.0%</td></tr>
<tr><td>Mobility as a Service (MaaS) and multimodal travel services</td><td>Improved integration between different transport modes. Integration of ticketing and increase of intermodal terminals/stations</td><td>Switching between different modes is twice as penalising as between the same mode</td><td colspan="2">Switching between different mode is no more penalising than between the same mode</td></tr>
<tr><td>Improvement in range and cost of all-electric planes</td><td>Development of all-electric aircraft</td><td>Flying range of all-electric planes increases by 2050 up to 1 000 km
Cost of all-electric aviation is 1.5 times that of conventional aircraft</td><td colspan="2">Flying range of all-electric planes increases by 2050 up to 1 500 km
Cost of all-electric aviation is 1.2 times that of conventional aircraft</td></tr>
<tr><td colspan="5">Exogenous factors</td></tr>
<tr><td>Autonomous vehicles*</td><td colspan="4">Introduction of vehicles with level 5 autonomous capabilities
The percentage of autonomous vehicles in use varies across regions:
for car 0% - 2.5%, for bus 0% - 1.25%</td></tr>
<tr><td>Reduction in long-distance leisure-tourism</td><td>Reduced tendency to take long-distance leisure trips as a consequence of Covid-19 pandemic</td><td>none</td><td>none</td><td>Long distance trips are reduced by 15% to 22% (compared to demand without this factor) between 2020 and 2030. The impact reduces linearly reaching 0% in 2050.</td></tr>
<tr><td>Reduction in business travel due to teleconferencing</td><td>Replacement of business trips with teleconferencing as a consequence of Covid-19 pandemic</td><td>none</td><td>none</td><td>Air trips are reduced by 12.5% (compared to demand without this factor) between 2020 and 2030. The impact reduces linearly reaching a 2.5% reduction in 2050.</td></tr>
<tr><td>Reduced propensity to fly</td><td>Segments of the population avoid flying due to climate considerations</td><td>10% - 15% fewer people fly in some regions in 2050</td><td colspan="2">5% - 30% fewer people fly in most regions in 2050</td></tr>
</table>

Note: Range of values reflect the varying degrees of implementation of policy measures across the different world regions in each scenario.

*Autonomous vehicles are considered but are not a primary factor in any of the scenarios. All scenarios assume a constant level of introduction of vehicles with Level 5 autonomy. The *ITF Transport Outlook 2019* focussed more specifically on transport disruptions, including autonomous vehicles, and assessed related scenarios

Source: extract from ITF (2021) Transport Outlook 2021, Table 4.3, p.142-144

ITF Southeast Asia Transport Outlook

This report provides scenarios for future transport demand and CO_2 emissions in Southeast Asia up to 2050 to help decision-makers chart pathways to sustainable, resilient transport. The scenarios reflect existing policy initiatives and specific constraints in the region. They also examine the potential impact of policies addressing the challenges and opportunities for transport from Covid-19.

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